RECEIVED
SEP 22 1921
THE CHEMISTS' CLUB
LIBRARY

CHEMICAL EXPOSITION—EXTRA EDITION

# Oil, Paint and Drug Reporter

Vol. 100. No. 14 TUESDAY, SEPTEMBER 20, 1921 100 William St., New York

MUTUAL CHEMICAL COMPANY
OF AMERICA

BICHROMATE
OF POTASH

BICHROMATE
OF SODA

SULPHURIC ACID 60°
IN CAR LOAD LOTS

110 William Street - - New York, N. Y.

*Factories:*

Jersey City, N. J. - - - Baltimore, Md.

# CONSUMERS PRODUCTS CORPORATION

## *How You Can Increase Your Sales and Build Up a Steady Consuming Trade, with a Minimum Effort*

### SPECIALTIES

**ACIDS**
- Citric
- Oxalic
- Carbolic
- Tartaric

**POTASH**
- Bichromate
- Bromide
- Carbonate
- Caustic
- Chlorate
- Prussiate

**SODA**
- Ash
- Bromide
- Bichromate
- Caustic
- Cyanide
- Hyposulphite
- Nitrate
- Silicate
- Sulphide

**OILS**
- Olive
- Soya Bean
- Cocoanut
- Castor
- Citronella
- Linseed
- Palm
- China Wood
- Olive Oil Foots
- Tallow

**WAX**
- Paraffine
- Vegetable Japan

**ARSENIC**
**ALBUMEN**
**AMMONIA**
**BLUE VITRIOL**
**CREAM TARTAR**
**EGG YOLK**
**EPSOM SALT**
**FORMALDEHYDE**
**GLYCERINE**
**NAPHTHALENE**
**QUININE SULPHATE**
**SACCHARIN**
**STARCHES**
**GUM CAMPHOR**
**MENTHOL**
**CHLORIDE OF LIME**
**QUICKSILVER**
**SHELLAC**
**SUMAC**

### FINANCING SHIPMENT

On any and all shipments that you will make, for local distribution, in this vicinity, we will advance up to 75% of the market value.

### STORING SHIPMENTS

All consignments made to us will be stored in our modern warehouse, and cared for, free of all costs to you. *Value of stock will be guaranteed.*

### MORE ORDERS

Being interested in the Chemical and Oil Industry in general, we solicit correspondence from Manufacturers, or from those about to go into the Manufacturing business.

With an experienced Sales Force, and an established Consuming Trade in this vicinity, we are in the position to market your commodities to advantage.

### SERVICE

Our policy is TO RENDER EFFICIENT SERVICE, with the the aim of attaining and maintaining a satisfied clientele.

### REFERENCES

We will furnish A-No.-1 Trade and Bank references.

## *Manufacturers' Sales Agents*

Office and Warehouse:
**65-67 OLIVER STREET**
BOSTON, MASS.

New York Office:
**13 PARK ROW**
NEW YORK CITY

**CORRESPONDENCE SOLICITED**

RECEIVED
SEP 22 1921
THE CHEMIST CLUB
LIBRARY

CHEMICAL EXPOSITION—EXTRA EDITION

# Oil, Paint and Drug Reporter

Vol. 100. No. 14 TUESDAY, SEPTEMBER 20, 1921 100 William St., New York

OIL, PAINT and DRUG REPORTER
ESTABLISHED 1871.

The following publications are incorporated in the REPORTER:—

DRUG, PAINT AND OIL TRADE
NEW YORK DRUG BULLETIN
NEW YORK DRUGGIST'S PRICE CURRENT
SOAP MAKERS' JOURNAL OIL AND PAINT REVIEW
WEEKLY DRUG NEWS

Published weekly. Mailed every Saturday under publication date of the following Monday, by the OIL, PAINT AND DRUG REPORTER, INC., at 100 William street, New York. William O. Allison, President; Harry J. Schnell, Vice-President; D. G. Bogert, Secretary.

SUBSCRIPTION TERMS. — For the United States $5.00; Canada, $7.00; other foreign countries, $10.00 per annum; single copies 15 cents each. All remittances should be made payable to the OIL, PAINT AND DRUG REPORTER, INC.

ADVERTISING RATES will be furnished upon application.

QUESTIONABLE OR UNDESIRABLE ADVERTISEMENTS WILL NOT BE ACCEPTED.

### This Extra Edition Covers the Chemical Exposition

This extra edition of the Oil, Paint and Drug Reporter has been made necessary by the fact that the Seventh National Exposition of Chemical Industries did not close until Saturday night, so that it was impossible to get the complete "story" of that important affair in the regular issue of September 19. We believe that our devoting of a special edition to a report of the exposition is clearly justified by the interesting and imformative nature of the contents of the pages which follow. Every subscriber for the Reporter gets this extra edition without additional charge.

This year's chemical exposition was a success. It set a new high record in attendance, and it was markedly helpful commercially. The record of its usefulness, herein presented, will be read with profit.

### INDEX TO PAPERS

Boiler Feed Water Treatment..... xxvi
Chemistry and National Welfare..... xxvi
Chemical Industries and the Tariff..... xiii
Crushing, Storing and Pulverizing Phosphate Rock vii
Disarmament and Chemical Industry..... xiii
Dye Plant of the du Pont Company.....xxviii
Educating Paint and Varnish Consumers..... xxiv
Ideal Paint or Varnish Specification..... xix
Importance of Chemical Progress to Our National Defense ..... v
Indicated Program for the Development of Paint and Varnish Technology..... xvii
Is There an American Dye Monopoly.....xxvii
Laboratory Control ..... xv
Limitations of Standardization in Paint and Varnish Manufacturing..... xxi
Opening Address of Dr. Herty..... v
Prevention of Corrosion..... xxvi
Pyrolytic Distillation of Coal..... xxvi
Reflection Factors of Industrial Paints and Pigments ..... xv
Rust: Its Cause and Prevention..... xix
Shall America Have an Independent Dye Industry? xiii
Solvent Extraction of Edible Fats and Oils..... ix
What Is Paint?..... xxv
Waste in Varnish Plants..... xix

# Seventh National Exposition of Chemical Industries

## The 1921 Chemical Show Attracts Over 100,000 Visitors—Foreign Chemists and Other Scientists Join with Laity in Crowding Exhibition Hall—Symposiums Supplement 400 Exhibits in Telling of Chemical Progress of America—Dyes and Paint and Varnish Have Big Days

More than a hundred thousand persons visited the Seventh National Exposition of Chemical Industries at the 8th Coast Artillery Armory, this city, September 12 to 17. At times the spacious armory floor where the exhibits were arranged was crowded to the full, an unmistakable indication that the American public has come to look upon chemistry as the universally beneficent calling that it is. Not only did the exhibits attract their tens of thousands daily; the addresses—and they were of a markedly important nature—were listened to with patent interest by capacity audiences, and the informative motion pictures proved as attractive as a five-reeler with a popular star.

As a business show the exposition was quite successful. Exhibitors report an interest in their apparatus or products which evidences the prevalence of a spirit of optimism tempered with determination to go ahead and break through the obstacles which, it is rapidly becoming recognized, are largely, if not wholly, psychological.

One of the outstanding features of the exposition attendance was the number of prominent men of science who were interested visitors at the various exhibits. Foreign visitors were much in evidence and their interest was as great as that of their American fellows.

Almost four hundred British and Canadian members of the Society of Chemical Industry visited the exposition headed by Sir William Pope, England's leading scientist in the field of warfare gases. Several hundred chemists from Mexico, South America, Porto Rico and Cuba were also among the much interested visitors. Scientific men outside of chemistry found a great deal to interest them among the exhibits. Thomas A. Edison spent one evening on a tour of inspection and expressed the opinion that the exposition, in completeness and scope, told the story of chemical progress in this country in a manner which all could understand.

A spectacular display of chemical warfare methods was given at intervals during the exposition under the direction of Major Kimberly of the Chemical Warfare Service. Gas alarms were sounded; smoke screens were raised; soldiers in gas masks plunged through in attack; and drills in preparing for gas onslaughts were given. Of course, the gases used were of an innocuous nature, but the demonstrations were remarkably realistic.

The division of the program of meetings into days for designated industries worked out well this year, and brought together great numbers of men with common interests in the several industrial group applications of chemistry. Paint and Varnish Day was an especially "big" one as a perusal of the papers reprinted elsewhere in this issue will show. The economic value of paint got a tremendous boost toward general public understanding. The exposition undoubtedly served the paint and varnish industry well in a commercial as well as in an industrial instructive sense.

Dye Day (Saturday) was another red-letter occasion. In fact the dye phase of the whole exposition, especially that of the exhibits, was of unusual interest and importance. The American public has a real interest in the problems of the dye-makers of the country. It has been fed up on so much talk on the subject (of which it knows little that is authentic) that the desire to learn more is strong. There was ample opportunity for everybody to get real information about American dyes out of the chemical exposition, and to judge from the questions asked of exhibitors of dyes and the interest given to speakers and motion pictures which had to do with the dye industry, thousands of persons went away from the armory well enlightened in that regard.

Before the exposition opened there was a little anxiety in the minds of those managing it as to whether the location of the exhibition building might militate against the attendance the importance of the affair warranted. As it was necessary to open the doors ahead of schedule practically every day, and as the exhibit hall, one of large proportions, was always crowded, their fears proved to be groundless. The facility for placing all the four hundred exhibits on one floor was one of the chief reasons for selecting the Jerome avenue armory, and it added not a little to the enjoyment of the show. The difficulty of getting displays to the armory was among the strongest influences toward the exhibitors' vote that next year's exposition be held in Grand Central Palace. The date most favored was the week of Septembr 11, 1922.

American chemistry has been on review. Its claims for recognition and protection have been passed upon by tens of thousands in every walk in life. Their judgment is not one of verbal verdict; it will come in their reaction toward the problems of the industry as they from time to time arise. Read the proceedings in the following pages, and the favorable nature of that judgment seems assured.

# —SCOTT—

# OIL EXTRACTION BY SOLVENTS

## PARTICULAR FEATURES

1. *Maximum Yield* of Oil or Grease.
2. *Low Cost* of Operation and Upkeep.
3. *Simplicity* of Working.
4. *Minimum* Loss of Solvent.
5. *Oil Suitable for Refining for Edible Purposes when Fresh Material used.*
6. *Handling* of *Wet Material Without Predrying.*
7. Production of *Dry Residue* Ready to Bag after Cooling.
8. *No Nuisance* with Disagreeable Odors.

We supply Plants in all sizes for Extracting Oil and Grease from Seeds, Nuts, Beans, Germs, Oily Residues, Fish, Fish Offal, Animal Waste, Packers Tankage, Etc., Etc.

SCOTT'S also manufacture *Vacuum Evaporators* and *Dryers, Distilling Plant* for Glycerine and Fatty Acids, *Impregnating Equipment,* Plant for *Wood Distillation,* Etc. Complete Plants for handling Animal Wastes, Etc. Complete Chemical Process Machinery.

## ERNEST SCOTT & CO.

FALL RIVER, MASS.

SPECIALISTS IN

INDUSTRIAL WASTE ELIMINATING

# Exposition Proceedings Day by Day

## MONDAY

Because of the crowd seeking admittance it was necessary to open the exposition at 1.30 o'clock Monday afternoon, a half-hour ahead of schedule. In a short time the exhibit hall hummed with the voices of thousands, and the inspection of the displays was on.

In the early evening came motion pictures showing "Iron Mining Operations," and "The Story of Abrasives." At 8 o'clock came the formal opening and the first of many interesting and instructive industrial conferences. The opening address was delivered by Dr. Charles H. Herty, who made the following plea for an awakening to America's need:—

### OPENING ADDRESS

*By Dr. Charles H. Herty*

Here in this great building is set forth the accomplishment of the American chemical industry. In its unification of exhibits is typified that new spirit which is spreading itself throughout the industry—no longer a heterogeneous mass of disjoined effort seeking more or less selfish and individual ends, but welded into a mighty whole, ready to serve our country, in peace we hope, in war if need arise.

The nation is invited to inspect and inquire. In turn the industry asks one question—Is not this source of national strength worthy of preservation? Shall its development proceed, that the industry may fully serve our needs? The answer lies not with the chemist, but with our people acting through their representatives in Congress.

#### *Penrose Changed His Mind*

Many industries represented here tonight, born of the nation's need in war and attesting the skill of the American chemist, face an uncertain future because of existing international conditions. Following the lifting of the blockade, measures adequate for the protection of these industries were promptly introduced in Congress and passed by the House of Representatives, but Senator Penrose dubbed these bills "popgun legislation" and decreed that they should await the drafting of the permanent tariff bill. They still wait. The Senator did not hesitate to change his mind, even more rapidly than a dye plant can be converted into a munition factory, concerning the tariff on agricultural products, but unfortunately the chemical industry makes more use of machinery and the forces of nature than of individuals who have reached the voting age. It would be a sad commentary if upon the ultimate enactment of protective legislation the industries are found to be no longer existent.

From certain quarters come loud cries of "monopoly," "trusts" and "pernicious lobbying" in criticism of American industries. These charges are made without one scintilla of trustworthy evidence in their support; nay more, in the very face of facts absolutely to the contrary set forth by the United States Tariff Commission. Strange how ready some folks are to hurl unfounded charges at Americans who seek to build up an industry which shall serve their country, and yet these same spellbinders completely overlook the greatest of all trusts, the German cartel, and the openly exhibited or exposed activities of its agents in this country.

#### *America's Argument*

The argument for the American organic chemical industry comes down to this: In the possession of a world monopoly Germany did and will have an economic club; from the plants under the control of the cartel came the high explosives and poison gases which enabled her so aggressively to prolong the war. Are we willing to submit again to her monopolistic control? American manufacturers ask a limited selective embargo. Who is it that cries loudest for protection through import duties alone? Every importer of foreign dyes. Official records show it.

In the present line-up in Congress party politics seem to be playing a part. The matter at issue is too vital to be treated from a partisan point of view. In his message to Congress ex-President Wilson twice urged special protection for this industry because of its potentialities other than economic. President Harding, as evidenced by his recent letter to Congressman Longworth, recognized clearly the significance of this industry.

Let selfish interests, the shortsighted and those who would jeopardize our country's welfare for a paltry commission stand aside and give place to the real voice of this nation, in which the spirit of independence still lives.

United States Senator Irvine L. Lenroot, who followed Doctor Herty, spoke as follows with reference to the importance of chemical warfare and the necessity for encouraging chemical industry:—

### THE IMPORTANCE OF CHEMICAL PROGRESS TO OUR NATIONAL DEFENSE

*By Hon. Irvine L. Lenroot*

I was very glad to accept the invitation to make the opening address at this important exposition, not primarily because of my interest in all fields of activity that make for the progress of our country, but because of my conviction that the future safety of our country from hostile attack lies in the development of our chemical industry, and I have chosen for my subject tonight "The Relation of Our Chemical Industry to Our National Defense." As a member of the Committee on Military Affairs of the Senate, it has been my duty to study the question of national defense and its cost to the taxpayers of America. It was not very long before I became especially interested in our Chemical Warfare Service and what we might hope for it in the future if properly supported. I found that 30 per cent. of our casualties in the war came from German gases. I found that although heretofore generally condemned as cruel and inhuman, results showed that casualties from gases were no more cruel than those from any other method of attack.

I found that the cost of preparedness through chemical warfare, the aeroplane and the submarine was the merest fraction of the cost of a large standing army, dreadnoughts and battleships and heavy ordnance. I found that although limitation of armaments may be agreed upon—and I hope will be agreed upon—chemical warfare is of such a nature, involving so little in personnel or cost of material, that it would be folly for any nation to rely upon any international agreement that poisonous gases should not hereafter be used in war.

Who won the war may be argued for the next generation, but the chemists of America and of our associates in the war have not received their due share of credit. But for the chemists of Germany she would have lost the war before we got into it. Had it not been for her progress in chemical industry she could never have secured sufficient explosives to save herself after the blockade against her was established. Had it not been for the chemists of the Allies meeting discovery with new discovery, Germany would have won the war.

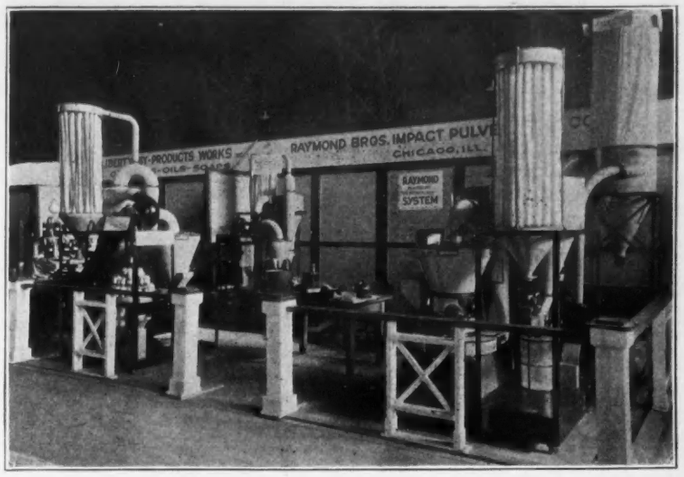
#### *Progress Since Armistice*

The progress in chemical warfare since the armistice has been remarkable, and too little realized by the people of the United States. Because of the advance made in explosives and gases and the development of the aeroplane, I verily believe the battleship has become obsolete, and that it is a waste of money to go on constructing them. This was proven, it seems to me, in the recent bombing tests, but only apart of our resources were then employed or could be employed. With an enemy crew aboard, with the dropping of gases upon them as well as explosives, their doom would be absolutely certain. The aeroplane, the aeroplane carrier, the submarine, gases and high explosives will be the implements of war of the future. We may agree upon a limitation of battleships, a limitation of submarines, a limittion of aeroplanes, a limitation of armies, a limitation of the quantity of war material that can be kept on hand, but we cannot agree upon a limitation of brains, and if we could, the limitation would be worthless. We must also understand that any agreement which may be entered into will be binding only upon honorable nations who may assent to it. If at any time one nation may desire to steal the property of nother, a written agreement not to use means which would enable her to do so will be worthless.

Let us hope that the conferenec to be held in November will mark the beginning of the end of large navies and huge armies, but let us not be idiotic enough to enter into any agreement that the scientists of the nation shall not employ their brains in research and developments that will assist in defending our nation should any dare attack us.

We can be prepared to defend ourselves at practically no cost by the encouragement and development of the chemical industry.

We have about 150 chemists now at Edgewood Arsenl doing splendid research work. Private industry has many chemists also doing research work, but unless private industry can exist and prosper, finding a market for their product in commercial life, either the government must employ more chemists, or men will not enter that profession. Private industry engaged in chemical production will give us a reserve in chemists, but will also give us plants that can be rapidlly converted for war purposes if the need shall ever arise. The Government in the last war spent hundreds of millions of dollars in new plants that would not have been necessary had the dye industry been as far advanced in the United States as it was in Germany.




Raymond Bros. Impact Pulverizer Co. Exhibit

#### *Dyes Strengthen America*

If the dyes used in America are made in America we will have the chemists and we will have the plants that will make America so strong in defensive warfare that none will dare to attack us. We should remember, too, that if ever attacked again, it is not likely that we will ever be in such a favorable situation as we were in the last war. For two and one-half years we had been making explosives for the Allies. Our chemists were employed in the development of high explosives before we declared war at all. We had two years and a half to prepare for that war before we did go in, and how poorly we were then prepared I shall not dwell upon tonight.

To conclude, I am convinced of two things:—

1. The importance of chemical warfare and the necessity for continued research and development.

2. The necessity of the encouragement of the chemical industry to insure a reserve of chemists, and plants that can be converted for the manufacture of explosives and gases should the need arise.

Let the nations of the world know that, although without even a large navy or army, while all our energies are being devoted along the paths of peace, nevertheless, we are possessed of the last word in science and invention and are ready to use it—that we have the skill and we have the material to defend ourselves—then never again shall any nation look upon us with contempt or mock our ability to make war.

Let us agree to sink our battleships, melt our cannon, destroy our fortifications, if other nations will do likewise, but let us encourage rather than destroy progress in discovery and invention making for the happiness and welfare of our people in time of peace and for their defense in time of war.

### CHEMICAL WARFARE

*By Gen. A. A. Fries*

General Amos A. Fries, Chief of the Chemical Warfare Service in the U. S. Army, in speaking on the vital importance of chemistry to the safety of any country, urges the development of by-product coking and the intensive manufacture of those coal-tar derivatives that are an essential factor in modern industry, commerce and chemical warfare.

"The world today demands, and will have, dyes, photographic chemicals, perfumes and medicines," said General Fries "The greater part of those in common use today are products obtained by refining the coal-tar from by-product coking. If we do not produce these substances other nations will. Every nation that possesses plants for these manufactures is, by that very fact, equipped to produce the most deadly agents of modern warfare, trinitrotuinol (T-N-T), and toxic gases. It is a simple matter to convert dye plants into munition factories, and on the return of peace to reconvert them into works for the production of innocent dyes and perfumes."

#### "Disarmament Cannot Disarm"

Explaining his statement that disarmament is only an economic measure, not an insurance against international conflagration, General Fries says, "No disarmament treaty could presume to forbid the manufacture of these necessaries of civilized life. Therefore disarmament cannot disarm. It may limit the size og navies, the size and number of guns, but it cannot prevent any nation advanced in the chemical arts from swiftly utilizing its dye plants for the manufacture of destructive gases and explosives which may be dropped from air-craft upon cities and armies in the country it desires to attack."

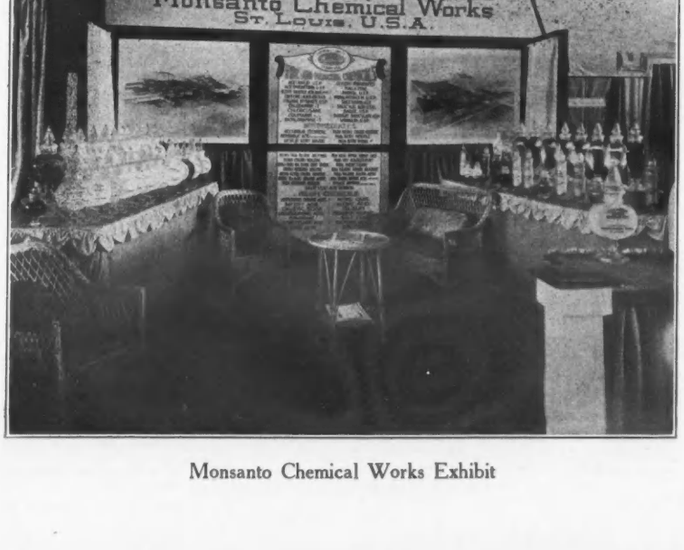
#### Poison Gas from Dyes

Already, according to the general, England, France and Italy and Japan have placed an embargo upon the importation of dyes. The British embargo is to endure for a period of ten years. Within that length of time any great nation would have developed the dye industry into formidable dimensions, and in doing that it also would have developed a great army of highly trained chemists, familiar with the multitudinous transformation of which coal-tar derivatives are capable. A highly specialized technical personnel is of greater importance even than the mere number of plants.

"Nearly one third of all the American casualties," said he, "were the direct result of poison gases and this deadly advantage was due to the tremendous advances made by German chemists in the development of dyes and related coal-tar products."

Since the war, the United States has developed the war-built gas arsenal at Edgewood, Md., where it is now able to match every gas used during the war and where it has developed new and more deadly gases than the Germans ever dreamed could be manufactured. In addition to these gases it has developed the powerful explosive known as anasite, nearly ten times more powerful than the deadly TNT. (trinitrotoluol), of which we heard so much during the war. But this development has only been possible because it has been able to call to the assistance of the country the scientific brains of the few synthetic chemists now available.

Aside from mustard oil and chlorine gas, the principal German weapons, the United States has developed phosgene, brom-benzylcyanide, chloracetophonone, Lewisite, the famous, but secret "D-M" and "D-A" gases, and many other gases. Many of these gases include large quantities of coal-tar derivatives, and during the past year the government has had to bear a very heavy overhead cost because it has been impossible to buy many of these derivatives in the commercial market.




Monsanto Chemical Works Exhibit

## TUESDAY

The second day's meeting was devoted to a symposium on "Crushing, Grinding and Pulverizing," under the direction of Harry J. Wolf, and to the consideration of industrial problems of oil extraction and the utilization of waste. The presentation of papers was begun at 2.30 p. m. with the address of Chairman Wolf, which was a brief but comprehensive description of the many processes employed in the chemical industry for reducing substances to particles of smaller size, with special reference to ores.

Henry F. Kleinfeldt, secretary of the Abbe Engineering Co., New York, presented a paper on "Ball and Pebble Mills for Pulverizing and Mixing." He claimed for those forms of mills the following advantages:—

1. Slow speed resulting in minimum wear and tear and low cost of maintenance.
2. Simplicity of construction. Therefore requiring no expert mill repair man.
3. Simplicity of operation. Reduces labor cost because unskilled workman can be used and one man can take care of a number of machines.
4. Dustless. Preventing disease among workmen and saving the fine material.
5. Economical. Where pulverizing and mixing are required in a process this can be accomplished in the one machine, therefore saving handling charges, loss of material and eliminating one machine besides giving a more thoroughly uniform product.
6. Wet grinding. Very often a problem presents itself where wet grinding is desirable and other types of machines not being suitable the ball or pebble mill is used.

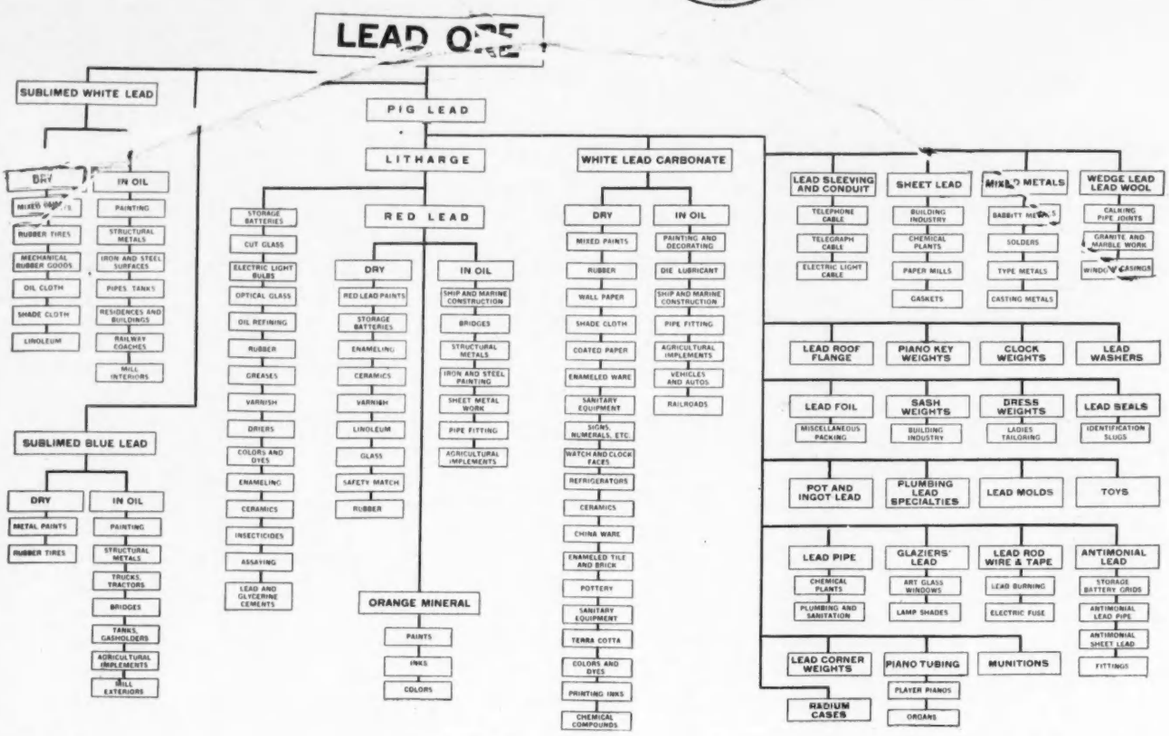
*Plants and Properties of*

## The Eagle-Picher Lead Company

*General Offices, Chicago*

*A LEAD Product for Every LEAD Purpose*

THE EAGLE-PICHER LEAD COMPANY — EAGLE — PICHER — ESTABLISHED 1843




THE comprehensiveness of the Eagle-Picher organization is best realized by a study of the above lead tree showing products derived from lead ore and the purposes to which they are put or the industries in which they are used.

The fact that products of this Company ultimately find use in every art and industry having use for lead is of little importance to the chemist and chemical engineer compared with the fact that through working with the consuming industries and in our own physical, analytical and research laboratories we have brought to a high standard of perfection the production of special lead products for special purposes.

The largest consumers of lead pigments in the country rate Eagle-Picher Products as the standard by which competing products are judged. It is an attribute of which we are justly proud.

## The EAGLE-PICHER LEAD Company

208 South La Salle Street, Chicago, Ill.

New York Philadelphia Baltimore Pittsburgh Buffalo
Cleveland Cincinnati St. Louis Kansas City Minneapolis

*Warehouses in All Principal Cities*

7. Special features. These machines can be easily modified in design so that for special problems the cylinder can be put under vacuum pressure or can be heated or cooled as desired, or for explosive materials an inert gas can be introduced into the mill.

An interesting paper on "Grinding and Pulverizing With Air Separation" was read by S. B. Kanowitz, of the Raymond Bros. Impact Pulverizing Co. Next on the program was the following paper:—

# CRUSHING, STORING AND PULVERIZING PHOSPHATE ROCK

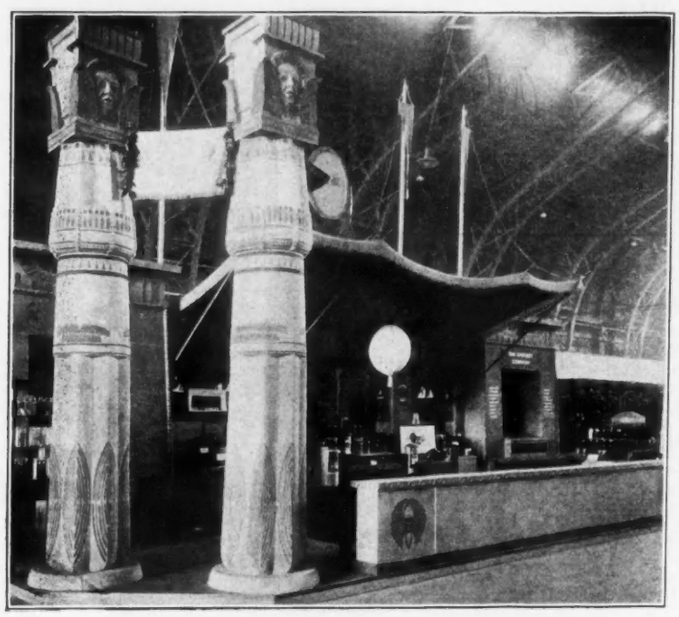
*By L. H. Sturtevant*

Vice-President and General Manager, Sturtevant Mill Co., Boston, Mass.

During the last decade crushing and pulverizing machinery has become highly specialized, and no longer is the "all-purpose" machine recognized in the modern plant. It has been found that machinery embodying certain principles is necessary to produce certain results, and by deviating from these principles inefficiency and a high-cost product, if not failure, is sure.

It therefore has been necessary for the machinery manufacturer to design many types of machines to accomplish economically the results desired in diversified fields. The experienced purchaser is not satisfied with simply buying an efficient pulverizer, for he realizes that such a machine constitutes only a small part of his plant. To produce cheaply he must arrange to receive, crush, pulverize, elevate, separate (if his material requires sizing) and provide storage for both raw and ground material. He must have power, shipping facilities and a suitable building to cover the equipment before his plant is complete.

It requires a man of wide practical as well as technical knowledge to design a plant and select the machinery and equipment best suited for any particular requirement. He must carefully consider the plant site in relation to the quarry or other source of supply of raw material; if at the quarry the advantages of a side-hill location, where gravity can be utilized; if raw material is received by boat or cars, the best method of unloading. He must consider the size rock to be handled, and if large, whether it will pay to install a crusher having a receiving opening of sufficient size to crush any size piece that can be economically handled, or whether it will be better to sledge and use a smaller preliminary crusher, thus saving initial expense; whether



Barrett Company Exhibit

or not the rock should be crushed before or after it is stored.

The method of storage and ability to reclaim material from storage with one handling and without excess labor is important, as is also:—

The most efficient pulverizer for his particular material and requirements.

Whether or not the pulverizer requires a separating device; and if so, will screens or air be more suitable and the best kind to use?

How and where shall the finished product be stored?

If dust collecting is necessary or advisable?

The best shipping facilities.

It is easily seen that no one article of reasonable length could cover all materials and the machines suitable for their reduction; therefore only phosphate rock will be considered in this paper.

Phosphate rock is mostly ground for the purpose of making acid phosphate, which is the principal ingredient in fertilizer, and, being used in large quantities, is handled mechanically to reduce labor costs, and its storage concentrated to economize space.

## *Unloading Power Shovel*

Any grade phosphate rock, with the exception of the very large pieces of Tennessee blue, is economically unloaded from box cars by means of a power shovel. By this method one man can unload a car in less than one hour. If hopper-bottom cars are used, a slight change in the unloading arrangement can be effected to serve equally well.

When rock is received in boats, grab buckets and electric overhead cars are employed to advantage for its removal.

When rock is taken from the car or boat it must be stored (also crushed, if lump rock is used). Rock storage is therefore arranged to allow for economy in crushing, if this is required, and for mechanically removing from storage and delivering to the grinding unit.

## *Crushing*

A swing sledge mill hoppered to receive the rock directly from the power shovel, is used for crushing lump rock. This mill is of the open-door accessible type, heavily lined, and carrying coarse grate bars which form the bottom and act as a rough sizing screen (to one inch).

Operated at one-half the usual speed, this machine is peculiarly well adapted to this preliminary work owing to its reliability, low head room, large capacity, free discharge, difficulty in clogging, even product, quick and easy accessibility, low power and small upkeep.

The mill discharges into an elevator of equal capacity to that of the power shovel and mill.

The unloading arrangements embody provision for by-passing the mill, when rock requiring no crushing, such as florida pebble, is used.

Several methods may be employed for storing the rock.

When possible, the silo type is preferred, because less ground area is occupied than when storing the same quantity on the ground floor of a building. Further, a belt conveyor placed in a tunnel under the silo easily reclaims the major portion of storage rock and requires little labor.

Rock piled on the ground by means of an overhead conveyor or car, which inexpensively places it in storage, cannot be readily or cheaply reclaimed. If a conveyor of any kind is placed under such a pile, the ground area is so great that only a small percentage is automatically reclaimed, and the remainder requires hand labor for trimming.

Storing rock in pile around the building is expensive to place and to reclaim, as much labor is necessary for either operation.

The silo is the cheapest form of bin for its capacity, and can be duplicated when increased storage is needed.

## *Pulverizing*

The grinding of phosphate rock is an important item in the manufacture of fertilizer, therefore has led to the development of many types of grinding mills more or less successfully used for this purpose.

The rock must be screened or separated after grinding to produce the required fine, uniform dust, and this feature is equally important to that of grinding.

The necessarily insufficient screen area of internal screen mills does not permit of the free discharge of finished dust as fast as made. In consequence, much effort is wasted and action cushioned by the grinding members working upon material already of the proper fineness, but which cannot escape. Therefore small capacity, large horsepower per ton of rock ground, excessive upkeep and clogging, due to damp rock blinding the meshes of the fine screens, have resulted in the practical elimination of such machines.

To overcome these objections other mills were developed, using large independent screens, entirely separate from the grinding mill. This system consists of a pulverizer, a circulating elevator and a screen. The rock passes through the mill, up the elevator and over the screen, where the fines are removed, and the oversize is returned to the mill for further reduction.

The maintenance of screens, however, proved expensive, as frequent renewals of the screen cloth were necessary to prevent leakage. The moisture element was also objectionable, as the best of fine screens coat over and require constant brushing to maintain capacities.

Grinding mills have not been materially changed, but air separators have been developed to overcome screen troubles.

The ring and roll mill air separator grinding unit stands pre-eminent for producing uniformly fine phosphate rock at minimum expense.

The vertical ring and roll type of mill is extensively used wherever phosphate rock is ground. It is a slow speed, durable machine, of rugged construction, and cannot be equaled for dependability, accessibility, large capacity, small power and low upkeep.

It grinds by enormous pressures exerted by powerful spring-pressed rolls against a layer of rock fed to the inner surface of a revolving ring and held thereon by the centrifugal force generated by the ring's rotations. The material crushes and grinds upon itself, and as there is no slip or rub to either ring or rolls durability is assured.

These mills run smoothly, quietly and almost without vibration. They are built on the "open-door" principle for accessibility. Opening the door, the work of a few minutes, exposes the whole interior for inspection or replacement of ring or rolls, the mills' only wearing parts of importance, which lasts several years.

The drive is by single belt, or, if preferred, by motor, direct-connected to the mill, with a silent chain running in oil.

The product discharged from the mill falls into an all steel elevator of the chain and bucket type, designed for this installation.

These elevators are built with steel casings, well reinforced, and with large clean-out or inspection doors, conveniently located for quick accessibility, and, being self-contained, permit prompt, easy and cheap installation. Steel encased elevators, carefully made, prevent the escape of dust, are fireproof, more durable and much more satisfactory than those of wooden construction.

Built with split head casings, self-cleaning boots, geared heads, self-aligning ball and socket bearings, they are foolproof and power savers. Automatic spring tension take-ups act as a relief to prevent breakage and automatically keep the chain taut.

## *Air Separators*

From the elevator the ground rock is discharged into an air separator.

This machine has been developed to produce a fine, uniform grade of phosphate rock dust and to eliminate the usual difficulties inherent to screens.

The principle of air separation is the passing of a current of air through a thin, falling stream of material at the required velocity to obtain the degree of fineness wanted and then to separate the dust from the air.

In this type of air separator centrifugal force is also employed to retard the coarser material, causing reaction against the air velocity and thereby insuring cleaner separation.

The material is fed onto a revolving plate which centrifugally distributes it in a thin stream, through which a strong air current is passed, removing all of the fine material, and thus a partial separation is accomplished.

This product is whirled spirally upward by the fan suction; the coarser particles, being more strongly acted upon by centrifugal force, are held within an inverted conical chamber, thus being prevented from following the fines or dust which pass upward and out with the air through a large slow speed fan, which carries them into a second cylindrical compartment. The dust is herein again rapidly whirled by the fan blast and the increased centrifugal force thus created is sufficient to cause the fine particles to cling to the exterior walls of this chamber, gradually working spirally downward by gravity.

A series of adjustable, tangentially arranged vanes surround the inner cylinder in the path of the return air current, and accelerate the already strong centrifugal effect, allowing the air to enter, but repelling the dust particles, which settle in a cone-shaped discharge hopper.

The same air is used indefinitely, the volume remains constant, and the desired fineness of product is obtained by regulating the fan speed and adjusting the openings between the vanes.

From 6 to 10 horsepower is all that is required to operate any size separator.

The separated dust, now of required fineness and deposited or settled in the discharge cone, is carried away to storage. The coarse or rejected particles are returned to the mill for regrinding. The air current is of low velocity, consequently little power is used and the upkeep is small. The use of an air current for separating tends to dry the material, therefore rock of higher moisture content can be ground more economically than when screens are used.

Cleveland-Cliffs Iron Co. Exhibit

## *Capacity*

The capacities of such a plant will vary according to the grade of rock ground, its size and moisture content, but such units generally have outputs of from 3 to 16 tons per hour according to size of machinery used.

Phosphate rock should be ground to a sufficient fineness to allow the acid to penetrate quickly to the center of the particles and to eliminate the small black specks sometimes found, as they delay reaction; 90 per cent. passing an 80-mesh sieve is amply fine for all requirements except that which is used for direct application to the soil, in which case 100-mesh is usually specified.

The phosphate dust should now be conveyed to a storage bin, preferably placed on the ground. The bin should be of sufficient capacity to contain one day's supply of dust so that in case of a shutdown in the grinding department the acidulating unit can continue working.

## *Dust Collecting*

Preventing the escape of dust in a grinding plant has obvious advantages; saving of dust, which has a money value, cleanliness, better working conditions, elimination of bearing troubles and wear, reduction of moisture in rock being ground, due to the drying effect of air suction, etc.

A dust-collecting system is simple and comparatively inexpensive. By tapping and piping the heads of three elevators, connecting these pipes with a filter, and using an exhaust fan, a sufficient suction is created throughout the system to collect the fine dust, which would otherwise escape, and place it in the ground rock bin.

The steel plate fan, especially designed for this service, discharges horizontally, at either right or left, or vertically, at either top or bottom, as desired; the pulley can also be arranged for either right or left hand drive to suit conditions.

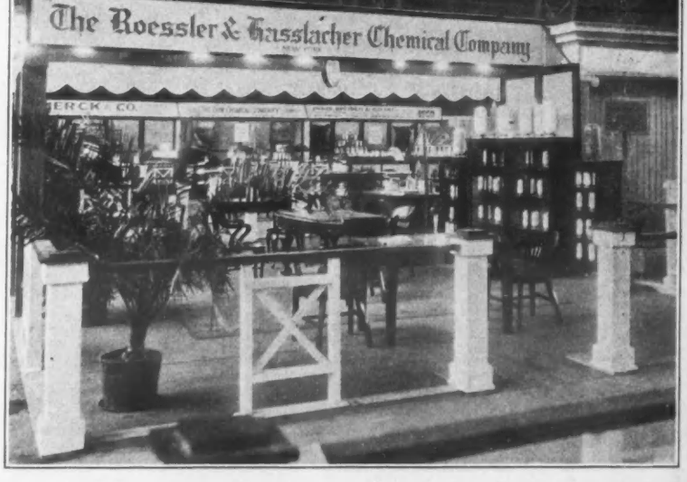
The dust passes into an automatic bag filter, wherein the air is cleaned, the dust being deposited on the bags, the air passing through the cloth texture of these bags and out by way of a duct through a fan which exhausts it into the atmosphere. Nothing passes through the fan but clean air.

At frequent and alternating intervals each section of bag filters is closed, the air current reversed, and the bags shaken to remove the adhering dust, which falls into the hopper below. These actions are accomplished simultaneously and automatically by a single, simple mechanism and require no labor. The accumulated dust is deposited by gravity in the rock dust bin.

Only three-horsepower is required to operate this unit.

M. I. Dorfan, of the Allis-Chalmers Mfg. Co., in a paper entitled, "Dust Collection as Applied to Grinding Problems," gave the following as the principal reasons for the installation of dust-collecting apparatus:—(1) Where this machinery is used as a direct part of a process, (2) the recovery and control of by-products and wastes, (3) the improvement of plant working conditions, (4) general sanitary improvement, (5) the abatement of nuisances. Mr. Dorfan illustrated his remarks with lantern slides.

Other papers in the symposium were:—"The Development of Compound Grinding




Roessler & Hasslacher Chemical Co. Exhibit

# Maurice A. Knight

## *Guaranteed Satisfactory*

MAURICE A. KNIGHT ACID PROOF CHEMICAL STONEWARE AKRON OHIO U.S.A.

# East Akron, Ohio

## *Chemical Stoneware*

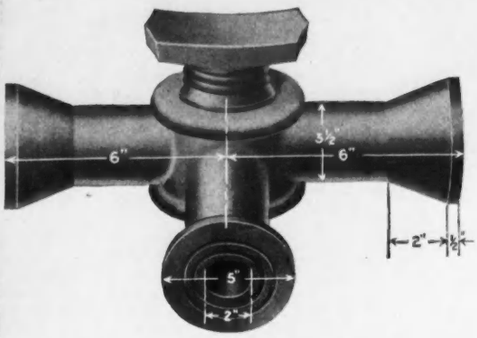



FIGURE 303

**CONICAL FLANGE 3-WAY VALVE**

Made with 2-way and 3-way keys, and in any bore from one-quarter inch up to 4 inches.

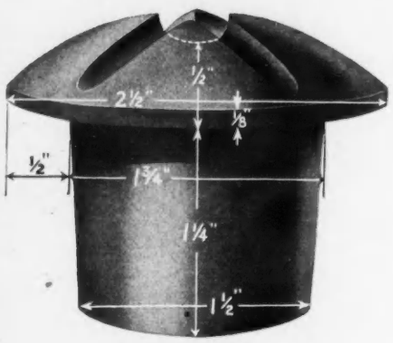



FIGURE 312

**STANDARD POROUS CARBOY STOPPER**

with grooves for wire bail. Although the body is hard and tough it is also porous so that the gas will escape and not allow Carboys to blow up in hot weather.

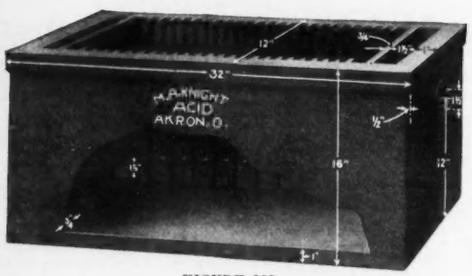



FIGURE 233

**ACID PROOF BATTERY OR FORMING TANK**

Showing plate grooves and partitions. Made in most any size or design.

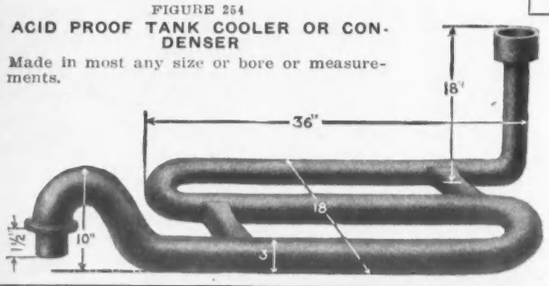



FIGURE 254

**ACID PROOF TANK COOLER OR CONDENSER**

Made in most any size or bore or measurements.

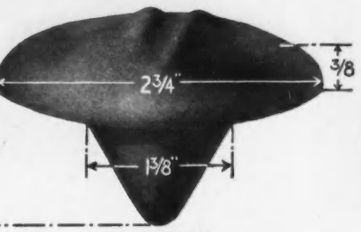



FIGURE 314

**ACID PROOF WIRE BAIL CARBOY STOPPERS**

This is a hard vitreous stopper with wide flange. Makes a tight fit to top of carboy. Carried in stock.

FIGURE 327

**ACID PROOF BUCKET**

Made in capacities from one to 10 gal. Furnished with or without handle or bail.

We do NOT depend upon a glaze, enamel or veneer to make our ware acid proof. IT IS IN THE BODY ITSELF.

We are the only plant in the country which is devoted ENTIRELY to the manufacture of acid proof chemical stoneware.

We make EVERY DESCRIPTION of acid proof chemical stoneware, from special pieces to complete plants.

Our Motto. SERVICE AND HONESTY IN DELIVERIES.

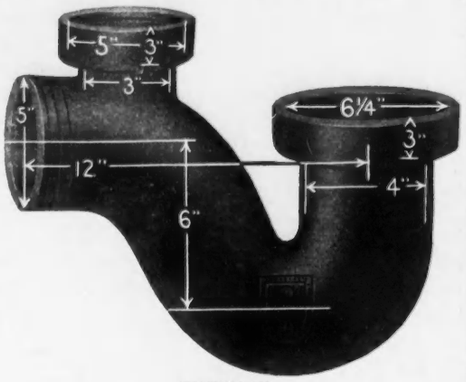



FIGURE 269

**ACID PROOF "P" SOCKET TRAP WITH CLEAN-OUT OR VENT**

We also make "S" and Running Traps in either socket or flange type and in any bore.

On account of reductions in labor, raw materials and overhead costs, our prices are now back to a pre-war basis.

As we have quite a representative stock of materials on hand we can probably take care of your requirements promptly.

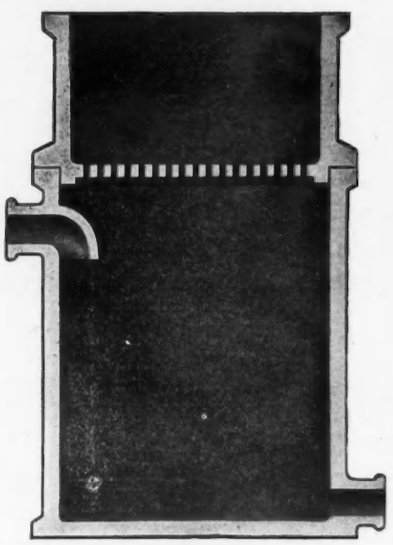


FIGURE 286

**ACID PROOF SUCTION FILTER "B"**

Made in any capacity up to 100 gallons. Furnished with faucets and cover if desired.

Used for open filtering on light or gravity suction, its chief use being in laboratory and similar work. For heavy duty and suction use type A.

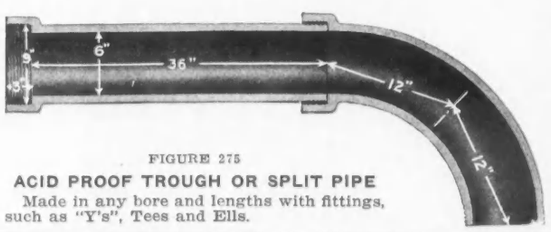



FIGURE 275

**ACID PROOF TROUGH OR SPLIT PIPE**

Made in any bore and lengths with fittings, such as "Y's", Tees and Ells.

Write for a copy of our fully illustrated folder describing acid proof chemical stoneware. It also contains information of interest on this subject. Submit your problems to us also as we can make chemical stoneware in most any design and size from blueprints or specifications, and can take care of your problems as well as we have for others during the 15 years we have been making chemical stoneware.

Mills," by H. Schifflin, of the Allis-Chalmers Mfg. Co., and "Mechanical Handling of Finely Ground Wet Material," by G. W. Repetti, of the Dorr Co.

First among the other papers in the day's session was the following:—

# SOLVENT EXTRACTION OF EDIBLE FATS AND OILS

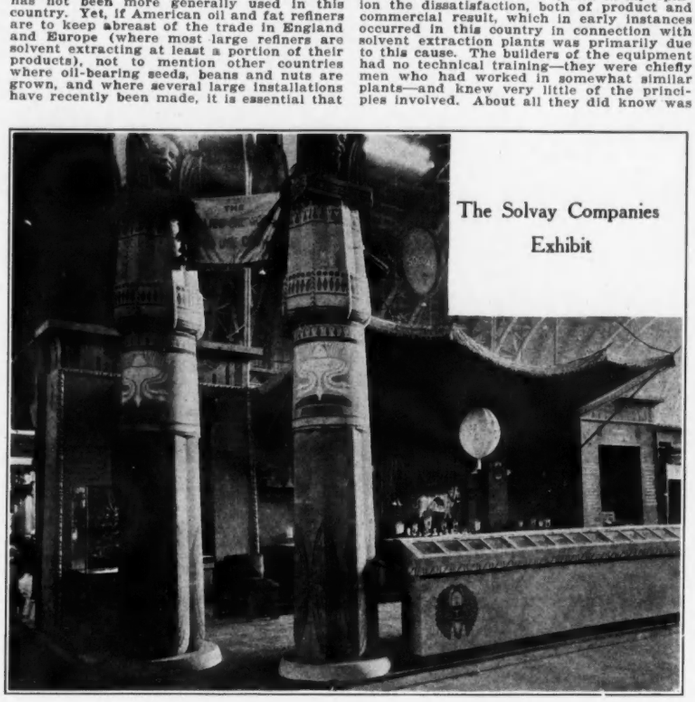
*By H. Austin*

Ernest Scott & Co.

Solvent extraction is now applied to such a variety of materials that in order to keep this paper within reasonable limits it is impossible to discuss the application of the principle to any particular commodity, and I shall, therefore, confine myself to general features which appertain in connection with the application of the solvent extraction process for obtaining fats and oils.

The main purpose of this paper is to direct attention to the suitability and advantages of solvent extraction for oils and greases which are finally to be used for edible purposes, but before taking up that phase of the subject I think it desirable first to endeavor to show how early prejudice and wrong application of the principle have retarded, and are still retarding, solvent extraction from showing what that method is capable of producing, not only in the product which is to be used for edible purposes, but for other general purposes also.

The higher yield and lower costs of production obtained by solvent extraction have always been recognized, so that there has obviously been counteracting influences thought to be sufficiently important why that system has not been more generally used in this country. Yet, if American oil and fat refiners are to keep abreast of the trade in England and Europe (where most large refiners are solvent extracting at least a portion of their products), not to mention other countries where oil-bearing seeds, beans and nuts are grown, and where several large installations have recently been made, it is essential that



The Solvay Companies Exhibit

earnest and careful consideration be given to the process as it is now conducted in a modern factory. The plants referred to are turning out products which compare favorably with those produced by other processes and from some of the raw materials used by the products, by solvent extraction, are even better. I shall try to show by what measures this effect is now obtained compared with the crude and unsatisfactory products formerly produced by the solvent extraction process.

Even at present low values, oil is more valuable as oil than as feed meal or as fertilizer, and refiners cannot afford to supply feed meal containing upwards of 8 per cent. of oil for cattle feeding purposes, nor can they afford to throw on the dump pile or dispose of to fertilizer manufacturers residues containing upwards of 8 per cent. of oil. The oil so left in factory residues is an economic waste. Oil is valueless as fertilizer and moreover is detrimental to the properties desired from fertilizer. Oil sours the soil, attracts insect life and is a repellent to the moisture which is so essential for the assimilation of the fertilizer by the soil.

## *Process Not New*

Extraction by solvent is by no means a principle of modern origin, and the improved result to which this paper directs attention has been primarily achieved by improved quality of the raw material from which extraction is now made, together with improvements of the type and design of the apparatus now used. An adaptation of the Soxhlet principle is utilized.

Until recent years there was little real designing shown in solvent extraction equipments, and the apparatus used was of a very crude type. The position of the builder of solvent extraction apparatus was made more difficult by the fact that the material to be extracted from was of the very poorest quality and chiefly the dregs and waste left over after all other processes had tried to extract the fat and oil stock and had failed. The comparison of the products which were obtained by solvent extraction was made with the product obtained by other processes, yet comparison was not made on the basis of the same raw material being used in the processes which were being compared, and in this way a wrong impression was obtained of the value of the solvent extraction product. It is useless, for instance, to compare oil obtained from an expression method apparatus working on fresh vegetable seeds, containing the full amount of oil which nature puts there, with oil obtained by the solvent process from the same seeds after they have been through the expression plant.

The first oil which comes from raw seed is always the best oil which the seed contains, and if that has been removed, the solvent extraction plant starts at a disadvantage from that cause alone. If comparison is to be made then it should be on the basis of the processes when working to produce a high grade product from spoiled and poor grade raw material, but yet the solvent extraction builder started with the incubus that the product which would be obtained would be of low value and consequently the capital expenditure which could be afforded on equipment was small and the design and construction necessarily became poor; also, the cost of operating had to be low, and the methods used, therefore, very crude.

## *Fire and Explosion Risk*

Another factor which was responsible for this condition was the misconceived idea that the use of solvent for extraction purposes necessarily increased fire hazard and that, consequently, it was a better commercial proposition to build any solvent extraction plant which had to be built from any old piece of second-hand tanks and other equipment that could be procured from the junk pile. To make any new installation for any purpose out of such class material is the surest way to disaster, whether looked at purely from the commercial result which will be obtained or whether it is looked at solely from the point of view of chemical process. That is particularly true where solvent extraction is involved, and in my opinion the dissatisfaction, both of product and commercial result, which in early instances occurred in this country in connection with solvent extraction plants was primarily due to this cause. The builders of the equipment had no technical training—they were chiefly men who had worked in somewhat similar plants—and knew very little of the principles involved. About all they did know was that oil and grease were soluble in naphtha. With such installation it is no wonder that the product obtained from these plants was poor in color and quality in addition to being saturated with solvent.

Without a doubt what was primarily responsible for early solvent extraction plants only being provided with low grade raw material was an incomplete and erroneous understanding of the solvent extraction project, particularly in regard to fire hazard. The real fact about fire and explosion risk is that solvent extraction equipment, when properly designed, constructed and installed, involves no more risk than any other machinery. This is proven by the fact that insurance company underwriters are willing to insure it at a very moderate premium, whereas they naturally taboo second-hand equipment whose history is unknown and unreliable.

While we still occasionally come across an instance where the view of the workman is apparently preferred to facts daily demonstrated in practice, it is now more or less recognized that solvent extraction is a highly specialized problem, and that there are builders of equipment experienced in the work who can be depended upon to furnish an installation under proper conditions and which will obtain due commercial returns. This is as it should be, for when one buys an automobile he does not go to a blacksmith shop, but to a factory specially equipped for the purpose of automobile building, and, in like case to the automobile business, solvent extraction equipment is now built by reputable concerns who have considerable experience in the work. One firm of my own knowledge has installed upward of 100 of these installations during the last twenty years, and the fact that all these plants are today in operation is fairly conclusive evidence that solvent extraction apparatus built and installed by experienced concerns will not only give complete satisfaction, but also shows that the upkeep charges are no more than on any other ordinary machinery.

These machines have been built and installed solely for the purpose of solvent extraction and with due regard to the principles involved. The system used is one involving low pressures and temperatures. No part of the plant as a general rule carrying more than five pounds pressure and ten pounds. They are operated by ordinary unskilled labor under ordinary management supervision. The class of material extracted varies in quality from junk bones and filter press residues to fresh butchers' bones and fresh oleaginous seeds, nuts, beans, etc.

## *Process Widely Useful*

Practically any material containing oil and grease can be solvent extracted far more advantageously than by the expression method, both in cost of operation and in products obtained. The fat stock is more completely extracted, and most materials can be extracted until the fat contents are under ½ per cent. reckoned on the residue weight, though it may be stated that as far as the fat stock value is concerned the cost of extracting below 1 per cent. usually only results in a new dollar being obtained for an old one. Sometimes, however, there is good reason for wishing to extract all possible fat, as for instance, when the residue bones are to be used for making glue and bone charcoal or when a residue meal or filter press residue is to be used for fertilizer straight without being mixed with any other ingredient. The residue left after the oil or grease has been extracted is enhanced in value whether it is to be used for animal feed purposes or whether it is to be used for fertilizer purposes. For instance, residue bones solvent extracted usually contain as high as 7 per cent. of ammonia reckoned on a 10 per cent. moisture basis, whereas bones which have been degreased by the steam or water boil processes contain less than half that amount of ammonia. The increased fertilizer value is obvious apart from the fact that the solvent extracted residue is more readily absorbed in the ground owing to the removal of the grease. Further, the more complete removal of the fat stock means that there is no opportunity for the formation of fat acids which on their part require some neutralizing agent in the fertilizer as previously mentioned.

Similar remarks apply in connection with solvent extracting from fish and fish offal, animal waste products, etc., as well as vegetable seeds, beans, nuts, etc., where the residue is to be used for fertilizer purposes, but, by means of an improved extraction system that I am now able to describe, a better use is usually found for the residue from materials of the latter class, and it is now used for feeding meals for hogs, dogs, poultry and cattle. For these purposes usually 2, 3 and even 4 per cent. of fat is left in the meal. That is done by the wish of the purchaser in order to have some fattening value in the meal. Should, however, the manufacturer of a feeding meal wish to reduce the fat contents to ½ per cent. solvent extraction will give that result even when using raw materials from which, by the best expression method, the residue contains 8 to 18 per cent. of fat, depending on the nature of the raw material. Modern solvent extraction equipment is, therefore, not only able to give higher yields, but has the further advantage that the amount of extraction can be more easily controlled within a given figure.

## *Drying Largely Obviated*

An objection sometimes urged against solvent extraction is that the material must be dried to 10 to 12 per cent. moisture content to make it suitable for the process, and further, that after extraction is effected the residue is so wet that drying after extraction has to be resorted to so that the process entails two drying operations in addition to that of the extraction. While this is true of most solvent extraction equipments, the objection cannot be urged against the apparatus made by the Scott Company, who have recently perfected the method which they introduced of using solvent vapor for evaporating the moisture, and this method enables solvent extraction to be effected from sloppy, wet materials without previous drying, as well as producing a dry residue. The wet raw material frequently containing 60 per cent. to 70 per cent. of moisture, as for instance, fish and fish offal, abattoir animal waste products, fresh vegetable seeds, etc., are placed in the extractor and the solvent vapor turned in amongst the mass.

The heat from the solvent vapor is imparted to the extractor's contents, thereby evaporating the water, first from the outer surfaces, but gradually from the whole of the raw material as the hot vapor is enabled to permeate through it. The solvent vapor naturally condenses on the colder surface of the raw material, and the solvent liquid, flowing over the surface, dissolves the fat. In this way the action of the solvent vapor may be said to be twofold: on the one hand evaporating the moisture and on the other hand extracting the fat stock. By proceeding in this way the temperature of the raw material naturally increases until the solvent vapor has evaporated the moisture and will pass through the material without condensing. At this stage the solvent vapor is diverted from the extractor and the latter receives a solvent liquor washing; or, as it is frequently termed, percolating, for the extraction of the balance of the fat in the raw material. That being effected the extractor charge of residue is saturated with solvent, which must be recovered in order to make the operation one which is commercially profitable.

Ernest Scott & Co. Exhibit

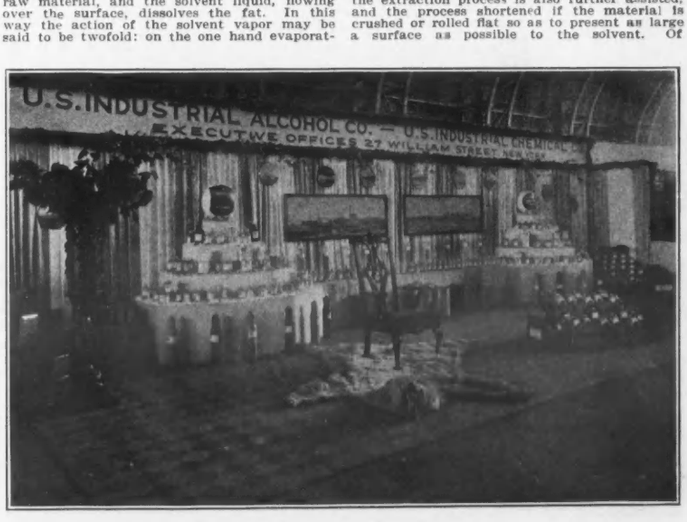
In the ordinary type extraction plant this solvent is recovered by blowing open steam through the residue in the extractor, but that naturally results in the steam condensing and making the residue wet, and hence the necessity for a further drying after removal from the extractors. By the "Scott" process, however, instead of turning open steam among the solvent saturated extracted residue, solvent vapor is again used to evaporate the solvent liquor absorbed by the residue and the operation is continued in this way until the temperature of the extractor's contents is about 220 to 230 deg. Fahr., by which time the whole of the solvent liquid in the residue (or, at any rate, the bulk of the solvent liquid therein) has been replaced by solvent vapor at that temperature, which then enables us to blow a relatively small amount of open steam into the extractor for the purpose of displacing and recovering the solvent vapor, and yet at the same time this steam does not condense in the extractor, but passes off with the solvent vapors to be condensed in the condensors. The extracted residue then comes out from the extractor hot and dry and does not require any further drying, as it will not contain more than 14 per cent. of moisture. In fact, in some cases the moisture contents are so low that the workmen handling the residue as it comes from the extractor have to wear respirators.

## *Food Values Maintained*

Owing to the relatively low temperature at which this drying method operates there is no chance of damage to the animal feed value of the extracted residue. In fact, on the contrary, the use of the open steam in the way and at the stage I have described, seems to have a digesting as well as a sterilizing effect, and not only does the feed keep better, as compared with that made by other processes from the same material, but a sweetening effect is obtained, and horses and cattle eat the feed with avidity even when hot. While this is not the reference to edible products intended by this paper, I would incidentally point out that this circumstance of horses and cattle eating of the extracted residue as it comes from the extracted product because hot, shows how perfectly the solvent is removed from the extracted product, because the fact is well known that horses and cattle have keenest smell and will refuse to partake of anything that smells strange.

By the means described not only is a better feed made from materials from which it is usual to obtain a residue suitable for animal feeds, but it is possible to obtain that result even from raw materials which, by other means, cannot be so utilized and are only good enough for fertilizer. Inasmuch as feed has a higher value than fertilizer, the advantage obtained by the "Scott" vaporizing method is obvious.

For extracting from beans and seeds such as castor and soya beans, flaxseed, cotton and sunflower seeds, etc., having a hard outer skin, same must be broken open in order to permit the solvent's access to the meat or flesh of the bean or seed. While it is not essential, the extraction process is also further assisted, and the process shortened if the material is crushed or rolled flat so as to present as large a surface as possible to the solvent. Of




U. S. Industrial Alcohol Co. Exhibit

# CHAS. PFIZER & CO.

INCORPORATED

ESTABLISHED 1849

## *Manufacturing Chemists*

## NEW YORK

Citric Acid Crystals, Granulated and Powdered
Tartaric Acid Crystals, Granulated and Powdered
Cream Tartar Powdered and Crystals
Rochelle Salt Powdered and Crystals
Borax Crystals, Granulated and Powdered
Boric Acid Crystals, Granulated and Powdered

Camphor Refined
Bismuth Subnitrate
Minor Bismuth Preparations
Seidlitz Mixture
Potassium Iodide, Crystals and Granulated
Iodoform
Iodine Resublimed
Chloroform
Potassium Citrate
Sodium Citrate
Tartar Emetic
Tannin

Calomel
Corrosive Sublimate
Red Precipitate
White Precipitate
Strychnine
Iron and Ammon. Cit., U. S. P.
Iron and Ammon. Cit., Green Scales
Other Scale Salts of Iron
Ferric Ammonium Oxalate
Ferric Potassium Oxalate
Ferric Sodium Oxalate
Ferric Oxalate Scales

**Also a general line of Chemicals for Medicinal, Photographic, Blue Print and various Technical Purposes**

WORKS AND LABORATORIES, BOROUGH OF BROOKLYN, NEW YORK.

course, all hard-shelled nuts, such as coconut, palmiche, corosso, etc., have not only to be broken open for the removal of the shell, but the inner nut must be broken open, and is preferably crushed and rolled flat.

Solvent extraction equipment consists of three essentially vital parts; viz., extractors, condensers, stills for separating solvent from the extracted fat, and a brief comment regarding the main conditions that these parts should fulfill is now necessary.

## *Two Types of Extractors*

Extractors are of two well-known types—the stationary and the rotating. Both use the percolation method at some stage of the operation and have the solvent trickling through the extractor's contents, the first runnings of solvent coming away richest in fat and gradually getting weaker as the material becomes exhausted of the fat.

Some users of equipment favor the rotating type of extractor because it seems to require less labor in discharging, but that is an entirely mistaken view, for stationary extractors require no more labor than the rotary type and are, moreover, free from disadvantages inherent to the rotary type, in which the charge of material is turned over in a mass without proper mixing and the heavy weight of extractor and contents have to be supported from trunnion bearings, which at the same time have to be used for passing solvent, solvent vapor and steam.

While I furnish rotary extractors and have applied for patent on an improved type which I hope will go far to remove the objections just mentioned, I personally favor stationary extractors, which are more simple to operate, particularly where several extractors are used, are less costly to purchase and require no more labor. For extracting from finely ground powdery material stationary extractors are furnished with slowly rotating stirrers, which insure that the whole of the material receives equal extractive treatment and prevents packing and short circuits during the operation.

One of the mistakes made by early builders of solvent extraction equipment was that of building the extractors much too large in their desire to make them handle large quantities. The result was uneven distribution of the solvent and the formation of pockets and short circuits, which in turn gave an unsatisfactory

Standard Oil Co. of N. J. Exhibit

product unevenly extracted and imperfectly separated from solvent. An essential condition for perfect work in any department of solvent extraction is intimate contact with the extractive mediums whether they be solvent, steam or condensing water. That is in fact necessary even when extracting by the expression method, whether it be an expeller or cage press, so that in arranging for similar action we are, after all, only adopting for solvent extraction a fact which has been long appreciated in other kinds of equipment used for separating the oil from similar raw materials.

## *Method of Procedure*

In the extractor the fatty material as previously mentioned must be thoroughly and evenly treated, first with solvent and afterwards with steam, and a large, unwieldly vessel is not conducive to the result. This is particularly true when first-grade products are required, as, for instance, when oil suitable for refining for edible purposes is to be obtained, and for such purposes an extractor of moderate size is essential. It is somewhat difficult to state a size which appertains for all materials, but in the case of oleaginous beans, seeds and nuts a vessel of moderate size usually capable of holding not more than 7,000 to 8,000 pounds has been found to give the best results. Not only do the solvent and steam have the opportunity to mix thoroughly and evenly with the extractor's contents, but the operation is more easily controlled and the time required for completing a charge cycle is shorter (usually not more than six hours), and so compensates for the size of the vessel by giving more charges.

The time of operating is important because, as is well known, a long continued heating with high temperature (and that is inseparable from the use of a large extracting vessel) will break down oils and fats and in any case cannot give so good a product as the short heating period at low temperature required in smaller extractor vessels. In the "Scott" extractors the average temperature is 150 deg. F. except at the end of the operation, when it reaches up to 225 deg. F. By that time, however, the oil or fat has been removed from the vessel. Right here is where there is a marked change in the design and operating of a properly designed modern extractor as compared with the early types and which still appertain in some European makes of apparatus with the result that poor products are obtained in which the presence of solvent is noticed without difficulty. These machines follow closely the Soxhlet principle, by which the extracted oil mixed with solvent drops into the lowest part of the extracting chamber and it is attempted to distill off the solvent and leave only the extracted fat. As, however, the solvent distilled off is continually condensing in the upper portion of the extractor and percolating to the lower compartment, it will readily be seen that it is futile to expect the machine to produce a fat free from solvent. The result can only be obtained by having separate vessels for performing the operations of extracting, condensing and distilling off the solvent from the extracted fat. This is particularly true where fat suitable for refining for edible purposes is desired.

## *Condensing Operation*

In the condensers also the water, which is used for condensing the vapors must be brought in intimate contact with the volatilized solvent vapors and steam coming to the condensers from the extractors and stills. The solvent is highly volatile and not easily condensed, particularly when mixed with air or steam, and the most effectual condenser is that having small thin tubes so as to divide the solvent vapor into small compartments surrounded by condensing water or alternatively, if it be necessary to use dirty water necessitating tube cleaning, to pass the condensing water through the tubes which are immersed in the solvent vapor. The larger the tubes used the greater becomes the volume of solvent vapor not in active contact with condensing surface. A condenser made from ½-inch or 1-inch copper or steel tubes sixteen BWG thick is a much more effective condenser than one made from 4- or 6-inch pipe, and if the latter be made from cast iron, as is frequently the case, the difficult of condensing is increased by the metal of which the pipe is made being seven or eight times thicker than in the case of the small tube condenser. Further, with the small tube the condensing water is passed over the surface with greater rapidity, which further increases its condensing efficiency.

In order to minimize the quantity of condensing water, I prefer to build my condensing surface in sections which are connected together in series by piping, and I introduce the vapor in a counter-current direction to that of the condensing water, so that the coldest solvent leaves the last of the condensing surface at the point where the coldest condensing water is entering and the condensing water leaves the condensing surface at the point where the hot vapor is entering. In this way I have the coldest solvent produced by a minimum of condensing water and the water is raised to the hottest temperature, so making it suitable for boiler feed and other purposes.

Tubular condensing surface arranged in this way is a vast improvement on condensing coils, not only in more effectual condensing and cooling of the recovered solvent, and thereby minimizing the solvent loss, but also in reducing the cost of condensing water, which usually has to be pumped or bought, by reducing the amount of water required and having it come away from the condenser in a hot condition, making it suitable for other factory uses.

I have now described improvements which have been made in the design and operating of extractors and condensers, and while that has been considerable, yet undoubtedly the greatest advance has been that made by the Scott Company in the type of the still which they have recently devised for separating the solvent from the recovered fat.

## *The New Idea*

Realizing the vital importance of devising a still which will insure a pure product being obtained, and having experienced some of the attendant difficulties in achieving that end, patent has been applied for on this new type still after having proven its efficiency. It is very much on the lines of a column still, and it really consists of a series of small stills superimposed one above the other. Each still section of the combined still consists of a shallow chamber in which there rests always during work a shallow layer of liquid fat solvent in varying degrees of richness. Projecting through the bottom of each still section are a number of necks or uptakes through which the vapor from the section or still below is permitted to pass. It cannot, however, escape freely on account of the cap with its saw teeth which covers the uptake opening, the teeth being submerged below the surface of the liquid. The steam and volatilized vapors can consequently only escape by bubbling through the layers of liquid in a number of minute bubbles. The fatty liquid is, by a series of baffles caused to pass in a tortuous direction to and fro before it escapes through the seal pipe into the next lower still section. In this way the oily liquid is searched progressively and completely by the rising vapors.

Each of the still sections is similar, except that they are alternatively left and right-handed in regard to the inlets and outlets. The oily spent solvent obtained from the extractor is fed into the uppermost still section and travels down through the lower sections, being at each section treated in the way just described by means of the rising steam and solvent vapors volatilized in the lower still sections.

The aim in this machine is to divide the oily spent solvent into thin layers so that the steam used for distilling off the solvent comes into intimate contact with the oily spent solvent.

The steam used for distilling in this apparatus is used always in the free form and is introduced at the lowest still section where it meets with the last trace of solvent and one having the highest boiling point. It will be realized from my further description that the oil in the bottom chamber contains only a most minute fraction of solvent. As a matter of fact, the flow of oily spent solvent into the still is regulated so that the two lowest sections are free from solvent in order to insure purity of the final product. It will be appreciated that the whole of the steam required for the entire work of distilling off the solvent is by this means caused to enter the still at the final stage of removing the last traces of solvent from the fat. The oil there then contains little or no solvent and, therefore, the steam which is introduced is applied at the time that it can do its most effective work on any solvent which does remain in the oil.

The steam is used on the oil, which requires the most searching treatment, and at that time the steam is in its most vigorous condition for effecting the work desired from it. The steam then passes from the bottom still section to the section immediately above it, where there is slightly more solvent, and in this way it gradually reaches (accumulating as it goes along an accompanying amount of solvent vapor) the upper still sections of the still. As the steam mixed with the solvent vapor rises it is used on solvent comparatively weak in oil and rich in solvent. At this stage the work is easy, and while the steam has lost some of its vigor it is still capable of doing this easier work quite efficiently. It will be obvious from this description that the steam volatilizes at the lowest still sections solvent fractions which are of the highest distilling point, and that the steam used is of sufficient temperature to volatilize this high boiling point solvent fraction, which, of course, mixes with the steam and passes on to the next still scetion above, where it volatilizes a solvent fraction having a slightly lower distilling point. This operation is repeated in each still section, the solvent fractions removed becoming lower in distilling point at each section.

Each section contains a layer of oily solvent through which the steam and higher boiling point solvent vapors are made to bubble, and thus volatilize the lower boiling point fractions of solvent. In this way the oily solvent is exposed to the maximum heating surface while in thin layer form, and the steam and hotter solvent vapors are enabled to do their maximum work toward volatilizing solvent fractions of lower boiling point.

The hot steam is only in contact as neat steam with the practically finished oil for a few seconds, because immediately it becomes mixed with solvent vapor the temperature of the mixture drops and the temperature rapidly decreases as the mixed steam and solvent vapors accumulate.

That in simple language describes the operation of this new type still which has resulted in producing from fresh raw material an oil which can be refined for edible purposes. The refining operation used is exactly similar to that used in the usual expression type plant. It will be noted that the still described is continuous and automatic in action. It is adjusted at the beginning of the work, and thereafter continues to the end of the operation without further adjustment, delivering oil free from solvent as long as the operating conditions remain the same as when first adjusted.

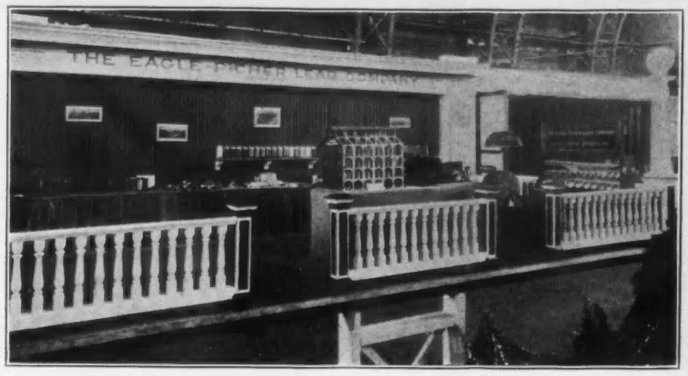
## *Solvent Wholly Removed*

The oil is definitely robbed of any trace of solvent, and from the time of entering the still to the time of leaving the still is only in contact with heat for about 12 minutes. This later is a very important feature, because in stills of the older form the continued long application (for several hours) of heating with wet steam has a detrimental effect on the quality of the fat and oil produced, both as regards color, flavor and the production of fatty acids. In the still of the new "Scott" type there is practically no chance for the fat to be broken down and form fat acids, and certainly, compared with the older forms of still, in which the extracted fat and oil are under the influence of heat for a long period, the new type still shows a big advance. The difference in quality of product and freedom from solvent which this new "Scott" still obtains, compared with, for instance, that produced in a pot of evaporator-type still, in which the amount of heating surface is large and the solvent removed by evaporation, is most marked.

In the pot still the oil gradually becomes greater in volume and the solvent decreases, but the last traces of solvent have to be carried by the steam through the increased volume of oil, and therefore it is a long and difficult matter to entirely eliminate the solvent. In the new "Scott" still there is no increasing head or volume of oil for the solvent to be carried through and the steam is best situated to do its appointed work. It will also be apparent that the cost for steam will be very much less in the new "Scott" still as compared with the evaporator-type still because the heat in the volatilized solvent is also used for distilling off the lower boiling-point solvent fractions. In practice it is found that about three-fifths the quantity of steam is required in the new "Scott" still as compared with a still of the evaporator type.

After the new "Scott" type of still I consider stills of the evaporator type as being next efficient and more nearly meeting the requirements of solvent extraction.

The old type extraction plants used large tanks with steam coils in them for separating the solvent from the extracted fat. This type of still is very crude in design, and the amount of heating surface to the amount of liquid is so small that the fat is necessarily under heat for a long period, which results in increasing the fatty acid contents and further, owing to the shape of the tank type of still, it is impossible to introduce the steam so that the last traces of solvent can be eliminated, and where solvent extraction plants use the tank type of still a forecast can be made that the extracted fat produced will contain solvent in very evident quantity.



The Eagle-Picher Lead Co. Exhibit

## *Suitable Solvents*

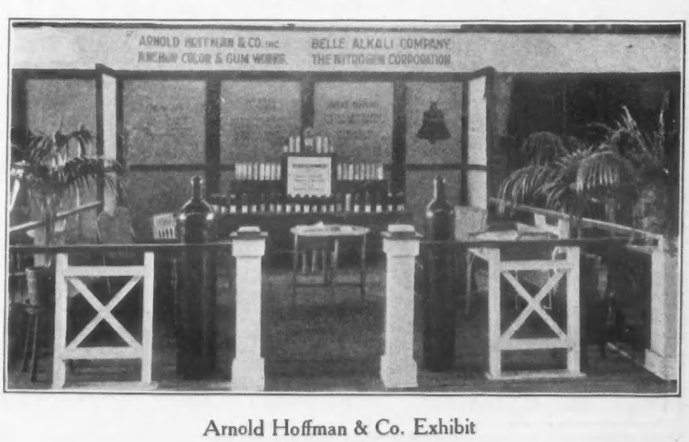
The question of a suitable solvent is an important one. In the first place, it should be easily procurble and in constant quantities and quality. It must not dissociate or decompose in use and should, so far as possible, have a constant boiling point. This boiling point should not be so high that it will be difficult to remove it from the fat and extracted residue by means of low temperature steam heat, nor should it be so low as to encourage loss by evaporation at normal temperatures. It should have a distinctly different gravity from water, so that it may separate cleanly, and it should not be soluble in water to any appreciable degree. These are the chief desirable characteristics.

Pure benzol, if really pure, is a very satisfactory solvent and has a close range boiling point, but if anything rather on the low side when all features of solvent extraction are considered. In this connection I refer to dryness of residue after extraction has been completed. Unfortunately, fairly pure benzol is extremely difficult to obtain, and what is termed pure benzol available in commercial quantities frequently has an impurity which leaves an odor.

The chlorine solvent compounds are certainly attractive because of their noninflammable nature, but unfortunately they, too, are not always suitably pure and, further, they are inclined to dissociate and break up in the presence of moisture and produce hydrochloric acid, which attacks the metal of the plant. Manufacturers of chlorine solvent compounds should realize that in solvent extracting on any commercial scale it is impossible to eliminate moisture.

At the present time there is nothing comparable in general suitability to benzine. High grade gasolines are perfectly suitable, particularly if refined in that part of the extraction plant which a modern equipment should have available for that purpose. In a modern extraction plant a conservative figure for the loss of solvent is about three to three and one-half gallons per ton of material extracted from. Better results than this are frequently achieved, but I am stating a figure which can be regarded as perfectly safe for the average practice. The operating costs, including gasoline solvent, steam and labor, in an average size plant, such as, for instance, handling per ton of material per hour, will at present prices cost from $2 to $2.50 per ton of material extracted from. Such a solvent extraction plant would today cost about $30,000 installed and put in operation. This price does not include building for housing the apparatus.

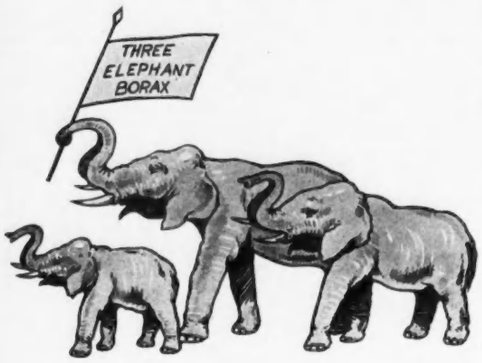
I hope that I have now shown how the early prejudices against the use of the solvent extraction process came about, but that these causes have now been removed and that solvent extraction equipment can now be obtained from manufacturers who are well acquainted with the requirements and that the apparatus will not only extract the fat stock more perfectly at lower cost of




Arnold Hoffman & Co. Exhibit

POTASH
KEMFERT
SALTS

# *Our Service on Potash Protects You Fully*




"Kemfert" made-in-America potash contains 90 to 98% Potassium Chloride, and gives you positive assurance of the highest quality obtainable. Every sale of "Kemfert" potash is backed by the unqualified guarantee of the American Trona Corporation, which is equipped to protect its patrons completely—on Quality, deliveries and price.

Let us tell you why our service on "Kemfert" made-in-America potash gives you additional safeguards. Write for our price and details.

# *We Are Your New Source of Supply for Borax*

"Three Elephant" Borax is 99.5% pure, and an analysis supplied with each carload leaves no doubt as to quality. Granulated or powdered. Sacks and barrels. Unlimited source of supply. Convenient warehouses permit of reliable deliveries.

When in the market for borax do not fail to get our price and full data on the co-operative service which we have developed for the benefit of borax users.

The American Trona Corporation, organized primarily to serve American markets, offers practical advantages which will interest you.

DISTRIBUTORS OF "THREE ELEPHANT" BORAX

Arnold Hoffman & Company
Providence, R. I.

Arnold Hoffman & Company
Boston, Mass.

Arnold Hoffman & Company
New York, N. Y.

Arnold Hoffman & Company
Philadelphia, Pa.

Thompson, Munro & Robins Co.
Kansas City, Mo.

Thompson, Munro & Robins Co.
St. Louis, Mo.

Charles Cooper & Company
New York, N. Y.

Fred G. Clark Company
Cleveland, Ohio

Hachmeister-Lind Chemical Co.
McKees Rock, Pa.

Maryland Chemical Company
Baltimore, Md.

Western Paper Makers Chemical Company
Kalamazoo, Mich.

A. Daigger & Company
Chicago, Ill.

Stanley Jordan Company
93 Water St., New York, N. Y.

Imperial Trading Company - - - Montreal, P. Q., Canada
Distributors for Canada

## AMERICAN TRONA CORPORATION

*Woolworth Building*
NEW YORK

production, as well as for cost of equipment compared with that entailed for any other method, but also how the products produced are of the highest quality and compare very favorably with those obtained by other processes from similar raw materials.

Other papers on industrial problems were:—"Materials: Handling in Industrial Plants," by R. H. McLain, of the General Electric Co., and "Utilization of Industrial Waste: Its Economic Importance," by W. H. Dickerson, of the Industrial Waste Products Co.

In the evening there were more motion pictures and an address by Congressman Purnell, as follows:—

## DISARMAMENT AND CHEMICAL INDUSTRY

*By Hon. Fred S. Purnell*

With almost methodical precision there has come to America some crisis to test the metal of her men. In all of these crises since the foundation of the government her sons have arisen to every duty. It was so in the world war. That great conflict brought the chemist into his own. The world war was very largely a poison gas war, and clearly demonstrated the fact that future warfare will be chemical. In this deadly war business American scientists made unusual and remarkable advancement. They had distilled a poison so deadly that whole cities and armies would have been annihilated almost before a defense could be begun.

Just as the world war was the means of bringing to the attention of the world the remarkable and spectacular achievements of American chemistry so a calm deliberation will remind us of our immediate duty. I think we are justified in saying that America has taken the lead in the world's chemical industry since the war. That position must be sustained, not only as a potential element of preparedness, but as a peace measure. The coal tar industry and the science of chemical warfare are so closely related that it becomes our paramount duty to protect the American dye manufacturer. The military strength of a nation will in the future depend almost entirely upon its dye plants.

### *Approves Disarmament*

I firmly believe President Harding's conference to consider the production of armament will bear fruit. It is our hope that this great load may be lifted, not only from the backs of our own people, but from the backs of the people of the world as well. Nearly 90 per cent. of our present taxes are directly chargeable to war—past, present or future. No one is more anxious than America to reduce this great burden to the minimum, but it would be a calamity and a national blunder to greatly reduce our armament without recognizing and protecting the great potentiality of our dye industries. With armaments reduced we must encourage the building of a great dye industry. Without it we could offer no effective resistance to a sudden attack from any nation which had one. As a matter of fact, do we not invite attack? Germany taught us the value of her dye works in the war. Every ounce of the poison gas they used so effectively was made in their dye works, and without any substantial change in their factories. She was ready without special preparation to almost instantly convert her peace-time dye works in to war-time gas factories.

America cannot afford to disarm unless we have a self-sustaining dye and coal tar chemical industry.

There are other very vital reasons why we need a native dye industry. The Tariff Commission estimates that $3,000,000,000 worth of American goods yearly depend upon coal tar dyes and intermediates for their manufacture. Shall we again turn to Europe for these dyes or shall we encourage their production at home?

### *Making of Colors*

The making of colors is said to be the most complex industry in existence. Prior to the war we were importing over 950 colors. Each dyestuff is produced by a separate process and requires many operations. The by-products are innumerable and the task of determining their possible uses furnishes an unlimited field for the research chemist. It is upon his success in finding uses for these by-products that the success of the business depends. It is therefore very important that we have every reasonable encouragement and protection to our new industry. In 1915 there were only seven dye concerns in the country. These seven concerns produced products to the extent of 6,619,728 pounds, having a value of $5,596,795. In 1920 the industry had grown until we had 90 concerns with products to the extent of 88,263,776 pounds, valued at $95,615,749.

If we are to save this industry, we must act now. Being an old-fashioned protectionist, it is not hard for me to advocate a measure of protection in this instance that will amount to an embargo. If it be not saved now, and encouraged as well as fully protected, American capital will never go into it again. World monopoly will be returned to Europe for all time.

Mathieson Alkali Works Exhibit

# WEDNESDAY

An interesting symposium on "Evaporating and Drying" was held Wednesday afternoon, Wallace Savage presiding.

Max Donauer, of the Elyria Enameled Products Co., read a paper on "Special Problems for Enameled Evaporators." His summing up of the subject follows:—

The field of enameled evaporators is for the most part a special one. It includes those operations in which the presence of an enameled surface plays an important part. Thus enameled evaporators are used for concentrating solutions which contain acids and for preparing products which must be kept free from contamination. The uniform heating conditions make enameled vacuum pans suitable for concentrating sensitive products which are apt to discolor or become caramelized. Enameled surfaces can be readily cleaned and this makes the evaporators very suitable for food and drug work. Indeed, in the preparation of many of the highest grade food and chemical products, enameled evaporators play an important part.

A seeming paradox was described by Arthur B. Stonex, of the Hunter Dry Kiln Co., in a paper entitled "Drying With Moist Air." His talk dealt with problems in the ceramic, textile, rubber and other industries.

"Evaporation" was treated by H. Austin, of Ernest Scott & Co. R. V. Cook, of the Chemical Equipment Co., told about "The Criss-Cross Evaporator," explaining why it was designed, what it is and what it does. His conclusion follows:—

In consideration of all that has been said, we can but conclude that the criss-cross principle is right and has a wide range of adaptability. The criss-cross evaporator is correct in principle and gives a wonderful performance. It is economical to install, economical to operate, and can be used for practically all solutions now being concentrated in vacuum evaporators. In many chemical plants, during these days of close competition and small margins, these attributes of the evaporator employed often mean the difference between profit and loss. We are, therefore, very glad to present the criss-cross evaporator to the chemical industry at this opportune time. With it goes an expression of hope that many shall learn of its possibilities, and, in taking advantage of them, shall profit thereby.

Others participating in the symposium and their subjects were:—E. G. Rippel, of the Buffalo Foundry & Machine Co., "The Recovery of Some Waste Materials Made Possible by Vacuum Drying and Evaporating"; A. E. Stacey, Jr., of the Carrier Engineering Corporation, "The Relation of Atmospheric Conditions to Chemical Processes"; H. S. Landell, of Proctor & Schwartz, "Drying and Drying Problems"; A. W. Lissauer, of W. L. Fleischer & Co., Inc., "Drying as an Air Conditioning Problem"; J. D. Stein, of Grinnell Co., dryer division, "Atmospheric Drying by Means of Compartment, Tunnel and Continuous Belt Conveyor Dryers"; W. H. Dickerson, of the Industrial Waste Products Co., "Spray Drying"; J. S. Chen, of J. P. Devine Co., "Vacuum as Applied to Industry."

In the course of the afternoon Harrison E. Howe delivered the following address:—

## SHALL AMERICA HAVE AN INDEPENDENT DYE INDUSTRY?

*By Harrison E. Howe*

The American people are confronted with a new problem, which may be called the dye problem, although much more is involved. It is often difficult to see a new problem as such, and in the present instance not only some of our lawmakers, but certain manufacturers as well, have failed fully to comprehend that here is something unlike anything we have had to solve heretofore.

History is the record of the efforts of men to solve the endless variety of problems that constantly present themselves as new developments take place. In most instances the greatest success has been achieved with new problems when new methods have been developed to deal with them. Failure follows those whose eyes are fixed on the past alone.

Our present problem is whether to cast aside our old friend, the tariff, and employ some new measure in the case of dyes and all that goes with them. It is said that the old methods do not apply and that the old measures will not accomplish the purpose. All seem agreed that the purpose should be to provide America with an organic chemical industry, for that is what the dye industry stands for in this problem. Perhaps if that were better understood we could think more clearly about the future, but, stripped of personalities and selfishness, the efforts of all would be for an American industry. The point subject to argument is how is the best way to bring it about.

There are those who think in terms of tariff and "infant industries." The dye industry—or, better, the organic chemical industry—is much more than an infant industry and so unlike other industries that the usual tariff prescription will be inadequate, in the opinion of unbiased students. This industry is a key industry—an adjective unused prior to the world war and indicating that such an industry must be preserved and developed, not so much for itself alone as for those other vital interests which depend upon it.

Now the war did establish a few things beyond argument. One was that America was dependent on foreign sources for most of her important medicinal products, which are all organic chemicals. Another, that we had no chemical plants capable of preparing the new weapons and defense materials of modern chemical warfare; that such warfare has come to stay until displaced by some still more deadly method, and that efficiency in such warfare is impossible without the organic chemical industry. Still another established fact is that a wide variety of colors are essential to many industries, and that it was easy to deprive us of them so long as they must be imported.

It is to relieve America from such dependency that our organic chemical industry must be retained and firmly established. The argument centers on dyes, for unless dyes are made we cannot have medicines, drugs, flavors, perfumes, war gases and all the other coal tar derivatives. Not another member of the group can operate on a scale to provide the raw materials and intermediates required at a reasonable price.

### *The Competition*

With a dye industry capable of supplying 30 per cent. of American needs why is strong protection needed? What is the competition? The great competitor is the same merciless monopoly which for many years prevented the establishment of any organic chemical industry than itself, and that monopoly has been made far stronger than ever before, is now composed of all the plants in the country where it is, and is not only completely backed by its government, but actually looked upon by it to take the lead in restoring that government to its former world trade position. Can any tariff shut out such a determined invader? It has never done so.

There are those who talk of an American dye monopoly, but it is entirely inconceivable that any monopoly such as we must fight could ever grow up under our conditions. But suppose it could. We have ways or can provide means for controlling American industry. We cannot control foreign monopolies and trusts and surely no one doubts that our textile, ink and paint manufacturers would be better off in the hands of an American controlled industry than at the mercy of a foreign monopoly.

One weakness of a tariff is due to the peculiarity of the dye trade. While more than a thousand colors and shades are made, the profit lies in those which can be made in quantity, such as the blacks, blues and reds. A foreign competitor need only select those few colors which are keeping a plant running and direct his competition at them, selling below cost for a time, wipe out American factories one by one, and grow fat on the lucrative years to come.

But why does this new industry require other types of protection? It involves processes intricate beyond the imagination of the average manufacturer and expense in development that surpasses all other industries. A single example will illustrate one of the many phases involved. Our dye production to date has been deficient in the widely discussed vat dyes. One important group of these colors is made from a coal tar product called anthracene. This anthracene is made into anthraquinone, which becomes the starting point for the dye. American coal tar contains plenty of the anthracene, but the usual methods of extraction leave the pitch residue too hard to be used in the ordinary American ways.

Abroad such pitch finds a ready market in the extensive briquetting of coal dust and coke breeze, so that there the anthracene is the by-product. South Americans could not make vat colors competitively until a market could be found for hard pitch or until some other way could be devised for getting anthraquinone from coal tar.

Does that not sound complicated for a tariff specialist? This problem affords excellent proof of the faith of American business that the right thing will be done. Research has gone forward until now a small company has begun the production of anthraquinone by a new electrochemical method which promises to eliminate all previous difficulties. But such development is very expensive and cannot be undertaken unless there is some promise of a market and ultimate return.

### *The Embargo on Imports*

It is to insure the American market to American manufacturers for at least the term of years required for proper development that the plan already adopted in certain other countries is proposed. Whatever the name given it, this plan, in essence, proposes that so long as dye users can obtain colors which are satisfactory in quality, quantity and price made in America they shall be prohibited from importing those same colors. Under other conditions they may be imported. That means that if a color not made here is needed it may be brought in until such time as an American manufacturer can meet the specifications, and to such a producer there is the prize of an assured market to be gained or retained for which to work.

The many benefits to America of an organic chemical industry are to be measured by possible advances in curative medicines, development of non-habit-forming drugs, encouragement to necessary research, many less important developments and adequate national defense, worth in the aggregate nearly any monetary price.

Should war come upon us again today conditions would exist favoring the industry, and we are far better off than in 1916-1917. It is

Antoine Chiris Co. Exhibit

Sherwin-Williams Co. Exhibit

The evening was devoted to a showing of motion pictures having to do with a wide variety of subjects from the manufacture of oleomargarin to the extermination of mosquitoes. Hon. Thomas Walker Page, chairman of the United States Tariff Commission, was the speaker of the evening. A summary of his address follows:—

## THE CHEMICAL INDUSTRIES AND THE TARIFF

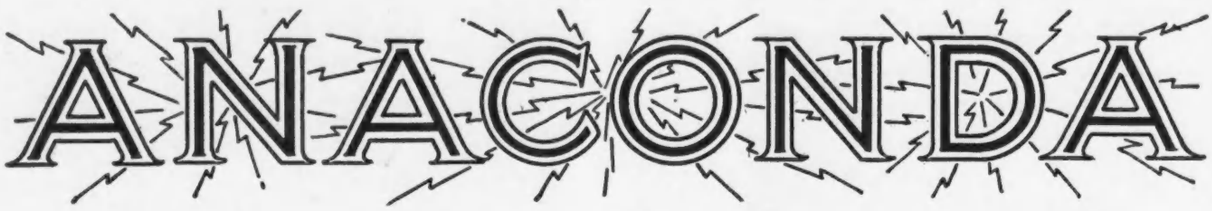
*By Hon. Thomas Walker Page*

Just what the tariff should be now or what it is going to be is indeed a question hard to solve, although everything is being done to hasten the work along. There are a number of causes for the delay in passing the tariff bill, and one of the difficulties is the gauging of the resistance that American industries can offer to foreign competitors, as both groups have grown to an unusual degree in the past few years.

The difficulties concerning the tariff are indeed great. It is almost impossible to estimate the competitive strength of American industries today. Industries abroad are offering problems that have to be met, and Congress must take all this into consideration. There is no wish to increase the cost of living by a high tariff, and yet the proper protection must be given to industry. Therefore, we must go slowly and carefully into the matter.

"Preparedness for Peace" is the slogan of today. The cost of production must be given great consideration, of course, in the basing of the tariff rates, and this cannot be figured accurately here, and it is, therefore, practically impossible to get the accurate figures from abroad.

Those who are framing the tariff bill




# TREBLE SUPERPHOSPHATE

(44% Available $P_2O_5$)

Use one-third the usual quantity.

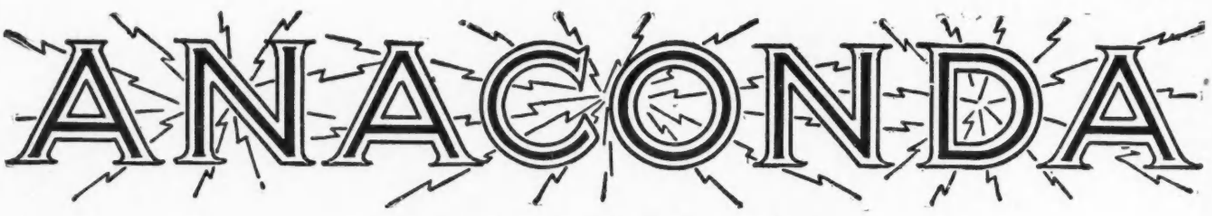
Save two-thirds the hauling and work.

Get better results.

ANACONDA COPPER MINING COMPANY
CHICAGO, ILLINOIS

---

USE




(BASIC CARBONATE)

# WHITE LEAD

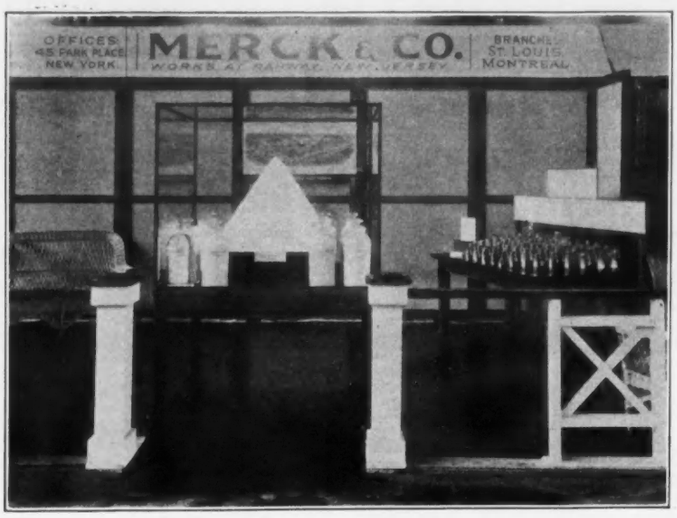
White Lead must be the preponderant pigment in a really good paint.

All modern methods of research emphasize the superiority of Anaconda over all other white leads.

Anaconda White Lead is essential for the best paints.

ANACONDA LEAD PRODUCTS COMPANY
1111 W. Washington Street, CHICAGO

*Warehouse Stocks in Principal Cities*




Merck & Co. Exhibit

realize that they must give the proper protection to the industries of the United States.

We are now producing of manufactured goods 25 per cent. more than our domestic market can consume. What shall we do about this excess? If we eliminate it, we must contract the scale of our manufacturing operations, and that means less labor, lower wages, smaller material account and a possible cancellation of commitments or engagements. If we continue this excess production, we must continue to sell it abroad. But what shall we take in payment? The foreign peoples do not have gold to send us, and we do not want it if they had. We must, therefore, take goods. But what kind of goods? That is the centre of the whole situation.

# THURSDAY

Thursday was "Paint and Varnish Day," and was featured by a symposium of prepared addresses delivered during the afternoon and evening. The sessions were presided over by Robert S. Perry, of Perry & Webster, Inc. The speakers at the afternoon session included L. P. Nemzek, of the laboratory division of Du Pont de Nemours & Co.; H. A. Gardner, director of the Paint and Varnish Institute at Washington; Frank G. Breyer, of the Palmerton Laboratories of the New Jersey Zinc Co.; Paul W. Webster, of Perry & Webster, Inc.; Maximilian Toch, of Toch Brothers, New York; F. P. Ingalls, chief chemist of John W. Masury & Co., Brooklyn, N. Y., and D. A. Kohr, of Lowe Brothers, Cleveland, Ohio.

In the evening were scheduled addresses by Ernest T. Trigg, chairman of the Advisory Committee of the "Save the Surface" Campaign, and George B. Heckel, secretary of the Paint Manufacturers' Association of the United States.

The text of these addresses, as they were presented by their authors, follows:—

## LABORATORY CONTROL

*By Leo P. Nemzek*

As in many other industries, chemistry has made remarkable strides during the last 15 years in paint and varnish manufacture. Laboratory control has taken on a new significance in the last decade. The importance of it is now quite generally recognized. In most of the large establishments it is well organized. There are only a few places where it is looked upon as a necessary evil, to be tolerated, to be sure, but a thing not to take too seriously.

There still exist, however, two types of factory control. The first, a direct reflection of bygone days, consists of the mere checking in of raw materials for plant use. There is no direct connection with the source of supply nor with the use of the material in the plant. The chemist is a mere cog in the wheel, with limited duties to perform. The actual performance of his duties is even more circumscribed. He is consulted only when the works get into difficulty. The information he is given is incomplete and at times wholly erroneous. There is evident a lack of confidence in the manner in which he is approached. Under these circumstances, if a satisfactory cure for the trouble is not forthcoming immediately, the chemist has again demonstrated his lack of usefulness.

Where such conditions exist the lot of the chemist is difficult, and yet in not a few such concerns men are doing good work today. The raw material control keeps the plant out of many troubles they would otherwise get into. Day by day time-worn prejudices are being broken down, and in their place is developed a confidence in the necessity for that type of service which ultimately leads to laboratory control on the scale which should be established in every up-to-date company.

Paint and varnish are so closely associated in many respects affected by laboratory control that the term "paint" as used will in most cases cover both types of products.

The paint business may be divided into three parts:—1, buying; 2, making; 3, selling. Laboratory control developed to its highest point must work hand in hand with these three divisions.

First of all, laboratory control requires a thorough knowledge of the raw materials essential to or suitable for paint and varnish manufacture. The laboratory working with the purchasing department sets up specifications for the material. Specifications must be sufficiently strict and complete to insure the quality of material desired. To make the specification more rigid than this works unnecessary hardship on the supplier and results in increased prices.

The mistake must not be made to write a specification for every material. In many cases it is entirely satisfactory and most economical to buy on sample submitted by supplier.

Once the standard has been adopted the laboratory can do a great deal of good by assisting the purchasing department in finding two or more sources of supply for the important materials. The advantages of more than one source of supply from a purchasing point of view are perfectly obvious. The laboratory really becomes consultant engineer to the purchasing agent, telling him what material is O. K., and which of two materials at different prices represents the more economical purchase.

### *Factory Control of Raw Materials*

One of the chief functions of the laboratory is the setting up of a factory control of raw materials. Each shipment of every material should be passed on by the laboratory. No shipment should be accepted without some kind of an inspection. The inspection may be physical or chemical or both, depending on the nature of the material. Pigments as a rule can be passed on such physical tests as color, fineness and strength. Some will require chemical determinations for one constituent or another, especially if they are used in finished products made on consumer specifications. Chemical constants should be run on oils and volatiles.

Instead of attempting to set up a general testing scheme for individual groups or classes of materials it is advisable to have a specific test control for each material. These tests should be just sufficient to insure uniformity of shipments.

The laboratory and purchasing departments must work closely together on the investigation of new materials for which a use may be developed in the industry. Good examples of such development are China wood oil and lithopone. Titanium oxide is now going through a similar process.

While laboratory control has its most direct association with production there are many points of contact with the sales department. Successful operation is measured largely by the contact with sales, and through them with the ultimate consumer. The paint technologist must know what the consumer requires from a point of service and what he desires from a decorative point of view.

This is true for the large line of what might be termed "trade sales products," or the products sold to the consumer over the counter by dealers. It is especially true of paints for industrial uses. The occasion arises oftentimes for the laboratory to suggest to the consumer the paint best adapted to his use or to work out with the consumer the most economical paint to suit the conditions which the coating must withstand. The sales department and laboratory must work in close harmony on matters which require the formulation of special paints, with the thought in mind of keeping such specials down in number and supplying already standardized products wherever this can be accomplished.

### *Laboratory and Sales Co-operation*

The handling of complaints offers one of the best avenues of sales department and laboratory co-operation. Nine out of ten complaints are due either to paint improperly applied as to time, surface condition or workmanship, or else the proper paint was not selected for the job. Yet in the handling of a complaint there is an excellent opportunity for displaying much tact and patience, besides bringing out all of the recorded facts and information available on the subject involved.

In running down a complaint it very often develops that the salesman needs as much education regarding the use of a product as the customer. The customer meant well enough but lacked proper information on how the paint must be applied. Also instances are not lacking where the operating and technical divisions did not understand the customer's requirements.

The major function of laboratory control is associated directly with production. The first requisite is a thorough knowledge of the products in which the different raw materials are used. A raw material record should be maintained, which immediately shows all products in which a particular material appears. This record is necessary in raw material development work, in advising the works where certain shipments of raw material may be used to best advantage. The record is essential in the adoption of raw material substitutions which are occasionally necessary.

Laboratory control must exercise a close check on new formulations. This may be a part of control work, or merely come under the general supervision of the chief chemist. A properly kept products index will help to keep down the formulation of new paints. Such an index shows in a moment a list of products of the same character or similar nature to the material under consideration.

The greatest value of the index lies in the standardization of formulas. All products of a certain type should be composed of the same ingredients. A thousand enamel formulas will vary only in the pigments necessary to give desired colors. The vehicle will consist of half a dozen standard varnishes, and not twenty or thirty, which might very easily be the case if standardization of formulas is not watched.

### *The Standardizing of Formulas*

Formula control eliminates the carrying of unnecessary bases in the works. There is no reason why ten similar products should each have a separate base. Almost every plant will show a condition where a number of products, each carrying a separate base, can be produced from a standard base, thereby eliminating much unnecessary carrying of stock. Better service to the trade is a result.

This holds true for ready mixed production, but the situation is reversed when it comes to pastes. Then the practice is not economy. There are cases where the use of two or three standard bases in producing a paste product means increasing the cost 10 to 15 per cent. over what it would be if the formula ingredients were put together separately. This increase consists largely of the added labor in form of making rates, and partly to ingredients which it is not absolutely necessary to use. For example, a base used in such a manner may be ground in refined linseed oil when raw oil is satisfactory and would be used if ingredients were put together separately.

Laboratory control does not end with the product, but includes the method of manufacture and the containers as well. Many complaints and difficulties are traceable to the can. The old hole-and-cap can gave no trouble on account of leakage or skinning over of products. The now more widely used friction top and roll-seam cans, while generally satisfactory for ready mixed goods, develop skinning over in paste products. A leaking package is readily detected, but skinning over due to a can that is not airtight is apt to concentrate a lot of attention on the product itself when the container is at fault. The goods may be unjustly condemned because of a faulty container, which can only be detected by very careful tests.

A simple test will quickly show whether or not cans are airtight. The empty can is sealed in the usual manner. A whole is punched in the body of the can. An air line of two to five pounds pressure is connected by means of a rubber tube to the hole in the can. The can is submerged in water, and the answer to most skinning over in oil and Japan colors and other paste products is readily seen.

Shipments of cans should be examined periodically. If a chart is prepared showing the average weight of each can, it is an easy matter to check the cans by weighing ten or a dozen from different shipments. The storage of cans should be watched. Much difficulty will be avoided if stocks are kept top or open side down. The can will not accumulate dirt and dust, which is not removed when the can is filled.

The checking up of measures in a plant will reveal many interesting things. The measures will vary considerably. This causes much confusion in the running down of problems that come up occasionally. There should be set up standard methods of filling out different types of products. Each container should carry its correct net weight or volume. In one-half gallon and gallon cans it is easy to give away a lot of paint. An extra one per cent. by volume is hardly observable on looking at the side of the container. Yet a one per cent. average on a production of 100,000 gallons a month amounts to 1,000 gallons of paint, which, at an average cost of $1.50 a gallon, means $1,500 per month loss.

There are plants today whose filling out methods are not standardized to even so close a margin. A study of the capacity and contents of samples picked up on the open market showed three cans with an average of one per cent. or more for one that was slightly short volume. It is necessary not only to standardize the methods of filling out, but to check them up frequently to see that they are being carefully followed by the men in the works.

The laboratory can assist the works in many of its operations. For example, there should be a control on the cooling water in mills, first of all to see that the flow of water is sufficient to keep the mills sufficiently cool; secondly, that the flow is not more than is necessary.

In one plant where a careful study was made of this point, an overflow system was developed which reduced the water bill from an average of $300 per month to not exceeding $40 per month. This control merely eliminated the human factor in the amount of water that was permitted to flow through the mills. This relates particularly to roller mills, because in the average stone mills they are so arranged that they handle only a very small stream of water, and in most cases the maximum is necessary to give proper cooling.

In the regulation of water, one must take into consideration different seasons of the year and variations in temperature of those seasons.

The efficiency of laboratory control can be greatly increased by the chemist spending more time in the works instead of being a bookworm and desk man. Rubbing shoulders with the men out in the works develops experience and information that can be obtained in no other way. It makes for confidence and a healthy co-operative spirit. The grimy urchin playing in a mud puddle always views with disdain the onlooking neighbor boy dressed in spotless white waist and velvet pants. But let the neighbor lad take a hand in making mud pies, naturally at the expense of clean collar, pants and shoes, and the two in the twinkling of an eye become the best of friends. They find that they are both kids after all—molded from the same clay.

The control of varnish products is in itself a big job. There is yet so much to be learned about the changes taking place in the cooking of varnishes that the present satisfies itself with the control of such properties as color, body, gravity, clearness and drying standards. Following making methods which have produced a certain result is counted on to give uniformity, although it is well recognized that large variations develop. These, especially in mixing varnishes, quite frequently lead to many perplexing production difficulties.

The control generally in connection with varnish is very much the same as in paint. One of the most fruitful sources of work is to keep the number of basic varnishes down to the lowest possible number consistent with most economical blending and storing.

### *Summary of Laboratory Control*

Laboratory control requires first of all a thorough knowledge of:—

1. The user's requirements of the paint and varnish.

2. The chemical and physical properties of available raw materials. How they react one with another, and what different combinations develop on aging.

3. Possessing the first two requirements: control or supervision over the formation of the most economical product that will give satisfaction.

Development work is essential both on raw materials and finished products. The field for research is large. The work that should be done is suggested by the conditions that arise in the usual routine functioning of technical control. The strictly routine functions of laboratory control are the checking of all raw material shipments and finished products so as to insure uniformity.

When production is distributed between two or more plants, there should be developed a complete manual of analytical and testing methods. This will eliminate much confusion which will otherwise arise, and besides result in many economies. After all, the efficiency of laboratory control and its value to the industry lies in the service which it performs and its dollars and cents' value as one of the necessary factors that go to make up a business.

Laboratory control, to be successful, must be practical. One of its major functions is the investigation of causes for troubles that develop in the production, use and service of paint, and means whereby such cases may be eliminated and improvements substituted.

Frequent contact with the men in the works stimulates the technical spirit in them. They exercise a greater measure of imagination in what their hands are doing. More careful production results. This leads to the making of many valuable suggestions.

Finally, laboratory control as exemplified by the chemist, scientist, technologist or whatever one may choose to call him must get itself on the same working basis as the man engaged in buying, making and selling to achieve the harmonious co-operation without which the maximum efficiency and value of this type of service cannot be achieved.

## REFLECTION FACTORS OF INDUSTRIAL PAINTS AND PIGMENTS

*By Henry A. Gardner*

In determining the reflection factors of paints, the standard for comparison has been magnesium carbonate, to which a reflection co-efficient of .88 was given by Dr. Nutting in 1912. Recently evidence has been accumulated which shows that this factor is considerably too low. This is pointed out in an article entitled "Measurement of Reflection Factors," by C. H. Sharp and W. F. Little, appearing on page 802 of the December 30, 1920, Transactions of the Illuminating Engineers' Society.

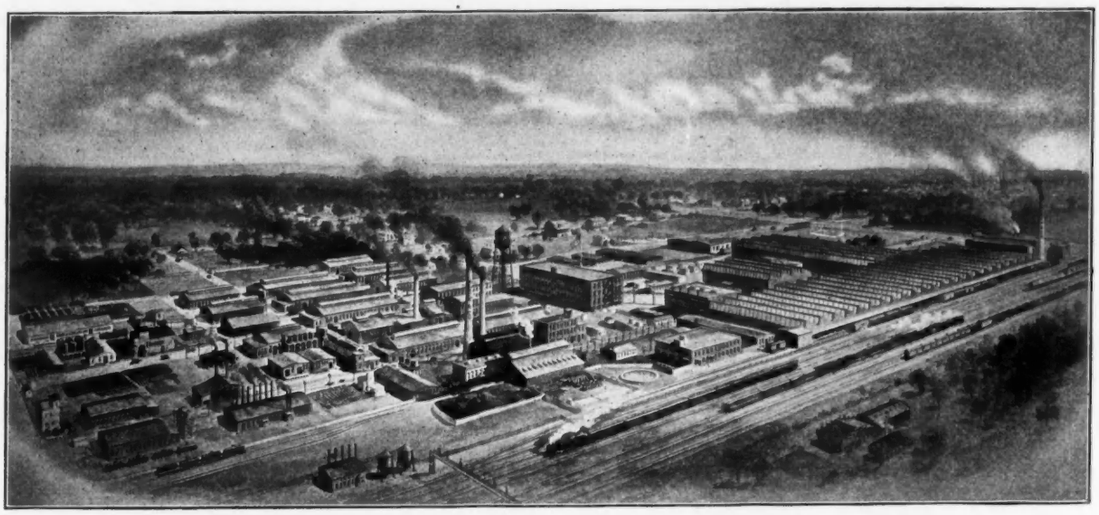
The work of Sharp and Little, together with the work of others referred to in the above publication, shows that the correct reflection factor for magnesium carbonate is .98. Heretofore, practically all measurements on paints have been calculated against the old reflection factor of .88 and so reported. These values, therefore, should be corrected

Maurice A. Knight Exhibit

# MERCK & CO.

## NEW YORK

**St. Louis** **Montreal**



**Works at Rahway, N. J.**

**MEDICINAL** **ANALYTICAL**

# Chemicals

**PHOTOGRAPHIC** **TECHNICAL**

to correspond to the suggested value of .98 for magnesium carbonate, by multiplying them by the fraction 98/88.

For instance, the reflection co-efficient of a white paint which previously may have been reported as 76 should be corrected to read 85. The possibility of having walls in factories so painted that they yield by reflection 85 per cent. of normal light is of great importance to the architect and owner.

During February, 1916, the writer prepared a paper entitled "The Light-Reflecting Value of White and Colored Paints," in which were shown the co-efficients of reflection of various wall colors compared with white magnesium carbonate (.88). Quite large size samples of the coated papers used in illustrating the subject had fortunately been kept in reserve. These had remained in a dark place over a period of five years. In May, 1921, they were taken out and the co-efficient of reflection of each determined. The results of the original tests (made in December, 1915) and those of May, 1921, are presented in Table I. There is also given in the table the co-efficient of reflection on the basis of .98 for magnesium carbonate as of May, 1921:—

### Table I

Readings on panels on tinted and shaded flat wall paper lithopone paints applied in 1915 and aged in dark place until 1921.

| | Coefficient of reflection Basis of .88 for magnesium carbonate. | | Basis of .98. |
|---|---|---|---|
| Time of observation— | Dec., 1915. | May, 1921. | May, 1921. |
| Light Cream | 66 | 62 | 69 |
| Light Pink | 60 | 57 | 63 |
| Light Yellow | 58 | 58 | 64 |
| Light Blue | 55 | 51 | 57 |
| Light Greenish Yellow | 54 | 54 | 60 |
| Light Buff | 52 | 54 | 60 |
| Light Green | 42 | 42 | 47 |
| Light Terra Cotta | 41 | 41 | 46 |
| Medium Terra Cotta | 39 | 39 | 44 |
| Light Greenish Blue | 36 | 35 | 39 |
| Medium Blue | 32 | 28 | 31 |
| Warm Green | 19 | 18 | 20 |
| Medium Green | 14 | 13 | 15 |
| Red | 12 | 12 | 13 |
| Dard Blue | 12 | 8 | 9 |
| Dark Green | 11 | 8 | 9 |

Reference to the table will show that light yellow, light green, light terra cotta, medium terra cotta and red suffer no loss in reflection value. Light greenish blue, warm green and medium green showed an average loss of only 5 per cent. of their original values. Light cream, light pink and light blue suffered a loss in reflection value of only about 6 per cent. of their original values. Dark blue and dark green showed an average loss of 30 per cent. of their original values. This latter result may be due to air oxidation of the colors to darker shades. Light buff showed an actual increase in reflection value. This result may be due to slight bleaching of the tint.

It would appear from these results that certain colors, through oxidation or otherwise, may become darker and thus lower in reflection value. While other colors remain stationary, some may bleach and thus show higher reflection factors.

In Table II are given some readings on commercial flat and gloss paints as of December, 1915, and May, 1921, based on .88 for magnesium carbonate, and as of May, 1921, based on .98 for magnesium carbonate. The panels coated with these paints had been kept in a dark place, and consequent yellowing of the liquid binder was indicated. The drop in reflection value is only about 10 per cent in five years. For the gray paints, an actual rise in reflection value is shown, and this is probably due to slight fading of the tints.

### Table II

Readings on panels of special industrial white paints applied in 1915 and aged in dark place until 1921:—

| | Coefficient of reflection Basis of .88 for magnesium carbonate. | | Basis of .98. |
|---|---|---|---|
| Time of observation— | Dec., 1915. | May, 1921. | May, 1921. |
| Gloss White X | 58 | 52 | 66 |
| White Enamel XX | 66 | 59 | 67 |
| Flat White X | 64 | 57 | 66 |
| Flate White XX | 60 | 54 | 69 |
| Light Gray | 44 | 47 | 52 |
| Medium Gray | 27 | 32 | 36 |

### Table III

Readings on panels of modern industrial white paints applied in May, 1921. Observations made in May, 1921, on basis of .98 for magnesium carbonate:—

| | |
|---|---|
| Exterior White Oil Paint | 71 |
| Non-Darkening Exterior Oil Paint | 78 |
| Gloss Mill White X | 74 |
| Gloss Mill White XX | 76 |
| Gloss Mill White XXX | 82 |
| Flat Mill White | 78 |

In table III are given the reflection factors of a few industrial flat and gloss paints now marketed. It will be noted that some of them run as high as 82 per cent., a figure extremely high in comparison with similar type paints marketed several years ago. This great advance in the production of interior industrial whites of high illuminating value has come as a result of many years of careful study and selection of the pigments and liquids available for the purpose.

## *Experimental Laboratory Work*

After the above investigation was under way it appeared advisable to formulate some method that might be used as a basis by laboratories in preparing paints and pigments to determine their reflection factors. Accordingly a series of tests were made to determine the reflection power of surfaces densely coated with various single pigments such as are used in the paint industry.

In order to apply the pigments to paper panels a quick drying binder was selected, which was made of nitro-cellulose solution in ethyl acetate plasticized with 5 per cent. water white castor oil, and having a total non-volatile content of 10 per cent. The product was practically colorless. Two parts by weight of the binder and one part by weight of pigment was ground together, the product in each instance being of such consistency as to make application by brush feasible. Two heavy brush coatings were applied to a series of high-grade bond paper panels, a period of one hour being allowed between coats. An attempt was made to apply practically the same amount of product to each panel. For this purpose weighed amounts were brushed out. Very flat, densely coated, matte surfaces of each pigment were thus obtained, having sufficient binder to prevent powdering.

It should be pointed out that the white bond paper upon which the paints were applied had a very high coefficient of reflection. While this paper was quite completely hidden by the opaque white pigments, so that the readings obtained were not affected by the paper, paints made of pigments of an inert character had comparatively low obscuring power, and the readings obtained were, of course, influenced by the white surface of the underlying paper. The reflection factors are given in table IV. Six of the paints used in the above series were then applied to clear glass plates in two-coat work. The coating gave to the glass various degrees of opacity.

### Table IV

Readings on White Paper Panels Coated With Pigments Applied in Nitro-Cellulose Media (One Part Pigment, Two Parts Liquid by Weight) During May, 1915. Observations Made in May, 1921. Basis of .98 for Magnesium Carbonate.

| | |
|---|---|
| Titanium pigment | 86 |
| Lithopone, grade A | 83 |
| Zinc oxide, French process | 83 |
| Antimonious oxide | 83 |
| White lead, type A | 79 |
| Lithopone, grade B | 78 |
| Zinc oxide, 5% lead | 77 |
| White lead, type B | 76 |
| Barium sulfate | 76 |
| Silica | 72 |
| Magnesium silicate | 69 |
| Calcium carbonate | 68 |
| Calcium sulfate | 64 |
| Aluminum silicate | 62 |

Note.—Paints made with inert pigments ground in nitro-cellulose media give films of greater opacity than when oil media are used. This is due to the refractive index of the nitro-cellulose films.

Readings were then made, placing the glass plates against a black background and against a white background (see table V). While the translucent character of the inert pigment paints is masked to some extent by the white background, it is quite readily shown by the black background.

### Table V

Readings on Pigments Applied in Nitro-Cellulose Media (One Part Pigment, Two Parts Liquid by Weight) to Clear Glass Plates, May, 1921.

| | Reflection factor— Black background. | Backed by white magnesium block (commercial). |
|---|---|---|
| Pigment. | | |
| Titanium pigment | 85 | 85 |
| Zinc oxide, French process | 80 | 81 |
| Lithopone | 80 | 82 |
| White lead, type A | 69 | 75 |
| Silica | 48 | 79 |
| Barium sulfate | 20 | 64 |

It should be pointed out that the results obtained and reported in tables IV and V are due to the difference in the light reflection of the colors of the paints as applied over white and black backgrounds. While the practical application of these results may be difficult, they are at least of some interest. It should also be pointed out that the tests in tables IV, V, VI and VIII were conducted on a weight basis. Had the pigments used been made up into paints with respect for the oil absorption values of each pigment some paints might have required twice as much pigment on the weight basis as others. Quite different results would then have been secured, but a variable would have been added to the work. However, this matter should be given careful consideration in drawing any conclusions from these tables.

In another series of tests the same pigments referred to above were ground in a liquid consisting of one part of flatting varnish and two parts of turpentine. The paints contained 66 parts by weight of pigment and 44 parts of liquid. This formula was adopted in place of one containing a higher amount (70 per cent.) of pigment, since it was impossible to make a workable paint with over 60 per cent. of certain of the pigments employed. These paints were applied in a similar manner to those described in table IV, but in place of paper a series of sheet-iron panels was used. These panels had previously been coated with a perfectly black, flat paint having a coefficient of reflection of about 5 per cent. The great hiding power of the opaque white pigments was at once evident from the appearance of the finished panels. The inert pigments, on the other hand, had but little hiding power in comparison. The results obtained from this series of tests are given in table VI.

### Table VI

Readings on Pigment Applied in Flat Liquids (Three Parts Pigment, Two Parts Liquid by Weight) to Black Panels, May, 1921. Basis of .98 for Magnesium Carbonate.

| | |
|---|---|
| Lithopone, A grade | 81 |
| Titanium pigment | 78 |
| Zinc oxide, French process | 78 |
| Zinc oxide, 5% lead | 77 |
| Lithopone, grade B | 69 |
| White lead, type A | 67 |
| White lead, type B | 50 |
| Calcium carbonate | 38 |
| Silica | 19 |
| Barium sulfate | 13 |

In a still further series of tests intended to develop the coefficient of reflection of dry white pigments a series of the same opaque and transparent pigments used in the previous tests were compressed into firm pellets about one inch in diameter and one-half inch thick. The readings on these are given in table VII.

The reader should also bear in mind that the hiding power of a paint depends largely upon the liquids chosen for the vehicle portion. The refractive indices of some liquids are naturally lower than those of others. The greater the difference between the refractive index of a liquid and that of the pigment the greater will be the hiding power of the paint. This is indicated by the results with nitro-cellulose media, which from a practical standpoint could not be used in many types of commercial paints, at least for wall work.

### Table VII

Readings on Dry Pigments Compressed to Pellet Form June, 1921. Basis of .98 for Magnesium Carbonate.

| | |
|---|---|
| Lithopone, Grade A | 91 |
| Titanium pigment | 91 |
| Zinc oxide, French process | 91 |
| White lead, Type B | 90 |
| Lithopone, Type B | 89 |
| Antimonious oxide | 89 |
| Barium sulfate | 88 |
| Zinc oxide, 5 per cent. lead | 87 |
| China clay | 84 |

### Table VIII

Relative Brightness of Pigments Applied in Nitro-Cellulose Media to White Paper Panels, May, 1921. Magnesium Oxoide Arbitrarily Given Value of 100 as Standard.

| | |
|---|---|
| Zinc oxide, French process | 92.5 |
| Titanium pigment | 90.2 |
| Zinc oxide, 5 per cent. lead | 88.3 |
| Lithopone, Grade A | 88.0 |
| Lithopone, Grade B | 84.7 |
| White lead, Type A | 80.7 |
| Antimonious oxide | 79.0 |
| White lead, Type B | 60.5 |

A series of the same nitro-cellulose pigment coated paper panels used in determining the results in table IV were submitted to readings for "brightness" in the Pfund instrument and gave the results shown in table VIII. While these results may have been affected by the white background of the paper used, they are at least of some interest.

## *Conclusions Drawn from Tests*

In conclusion, it would appear that the following information was gained from the above tests.—

1. Commercial industrial paints for interiors are now available, of greater reflecting capacity than heretofore.

2. In computing the reflection factors of industrial paints, the factor .98 should be used for magnesium carbonate (the standard) rathen than .88.

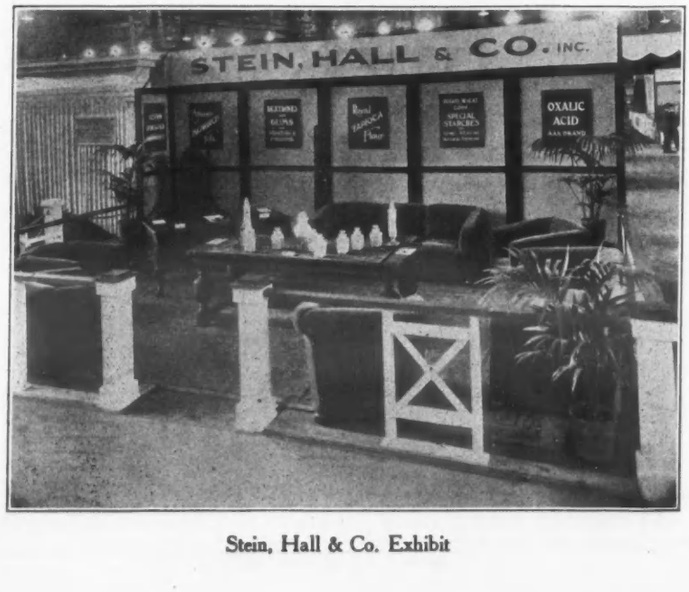
E. I. du Pont de Nemours Co. Exhibit

3. White paints may show a small loss of reflection value after remaining in a dark place for several years, due to yellowing of the oil content. This loss, however, is probably much less than would occur when paints become darkened due to dust adherence, even over a short period of time. For the walls and ceilings of factories a paint is desired that will initially and permanently give the highest degree of reflection. Off-color products or those that show rapid yellowing of the oil content are considered unsatisfactory.

Tinted and colored paints may or may not show a loss in reflection value upon ageing. The result will vary with the type of tinting color used.

4. White opaque pigments vary in reflection value. It would appear that the greatest reflection is obtained from pigments with the greatest opacity.

5. For determining the reflection factors of industrial paints, it is suggested that two coats be applied under standard conditions to black iron surfaces previously coated with a continuous coat of flat black primer. For this purpose, the same amount of each paint should be applied, as determined by weight of paint applied.




Stein, Hall & Co. Exhibit

# AN INDICATED PROGRAM FOR THE DEVELOPMENT OF PAINT AND VARNISH TECHNOLOGY

*By Frank G. Breyer*

Paint technologists have assembled and built up a literature containing a vast number of partially classified sets of data. If we are honest with ourselves, however, we are forced to admit that the correlation of the data and the rationalizing of the phenomena the data reports have attained practically no degree of success.

A field of knowledge may be said to have attained the dignity of a science when it has analyzed a complex status into a number of elements or casual relationships, and derived at least a few generalities as to the conditions under which these elements may combine to form complexes, or the casual relationships be made to mutually act toward a definite result. In this light there is a paint science, but it is in a very primitive stage of development. The art of decoration and protection by applying liquid or semi-liquid films which fit themselves to a surface and harden there is far ahead of the science which attempts to rationalize the art.

Paint science to be in accord with the art must rationalize (1) Suspension (mixing or incorporation); (2) Life of suspension; (3) Application; (4) Conversion of applied material to adherent film, and (5) Life of film.

If you will examine critically the contributions to the literature on any one of these five phases of paint science you will find that practically every attempt to explain the observed phenomena has been a purely chemical one, and has failed of conviction because the chemical analysis has preceded or gone without any previous physical analysis. Probably 95 per cent. of our paint technologists have been chemists, and have viewed the problem from too strict a chemical point of view.

I need not go very far into the first phase of the subject, namely, suspension, to show the dire need of more physical means of attack (more physical instruments) and more physical reasoning. From the suspension point of view, for example, pigments have been divided into active and inert pigments—the difference between the two being that the one is acted upon chemically by the vehicle and the other is not. This much is certainly worth while, but leaves the question of the many well-known differences between two pigments of the same chemical composition entirely up in the air.

## *The Laws of Suspension*

What is known about the laws of suspension even in water, the commonest suspending medium? Rationalizing ore flotation has given us in the last few years the only clarity on this subject. Sulman (Bull. Inst. Min. & Met., No. 182, Nov., 1919) has shown that the degree of dispersion of a two-phase system, the continuous phase of which is water, is dependent upon the degree of wetting of the disperse phase by the continuous phase. Green (Proc. Amer. Soc. Test. Mat., 1921) has shown very clearly that the consistency of an oil or varnish suspension is dependent upon the degree of dispersion. Connecting these two together constitutes probably the first and only physical law underlying the suspension phase of paint science.

This law may be stated as follows:—The consistency of a suspension is dependent upon the degree of wetting of a pigment by the vehicle. The microscope and the plastometer have been responsible for this fundamental law, and it is through these two instruments alone that consistency can be understood.

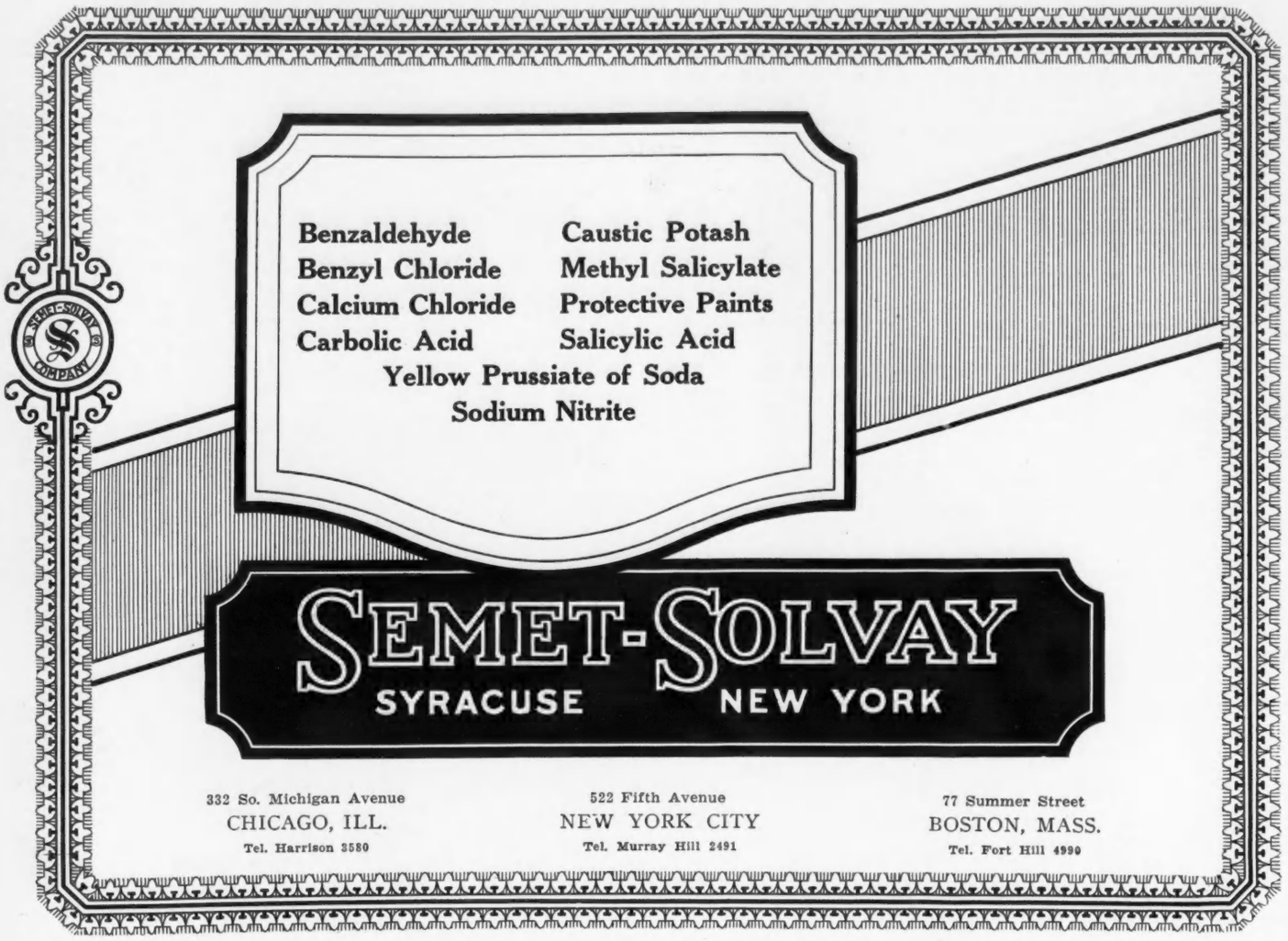
Through this conception we rationalize a great part of vehicle preparation. Thin mineral oils wet pigments but slightly, and always yield highly flocculated suspensions which have no flow or smoothing out properties.

Raw linseed oil has some wetting power, which increases with increasing acid number, among other things. The smoothing out properties of such a suspension are fair. As soon, however, as bodied vehicles are used, dispersion becomes more and more complete, and the suspension becomes an enamel. The higher the grade the greater the degree of dispersion, which may be tested by the amount of pigment that goes through a given filter when the suspension is thinned down. Most livering, thickening or thinning down of paints on standing can be explained on the grounds of continuous increased or decreased wetting of the pigment by the vehicle.

Changes in consistency of the vehicle or continuous phase have not yet been clearly proved, although it is possible that with highly acid vehicles enough soap may be formed to change the viscosity of the vehicle either by their greater viscosity in solution in the vehicle, or by increasing the amount of solid in suspension by crystallizing out as soap crystals. None of the common paints that we have examined, however, have shown either of these last two phenomena as a serious contributing cause to change in consistency over any short period of time.

Rationalizing "application" can only follow more knowledge of surface phenomena, and the paint and oil technologist must develop instruments first before he can build up this knowledge.

Experienced human judgment is the only




Our "BLACK" reputation is the result of many years of service and quality, which we intend to maintain.

## BLACKS FOR EVERY FORMULA

Carbon
Bone
Drys
Ivory
Mineral
Oxide

## BINNEY & SMITH CO.

81-83 FULTON STREET NEW YORK

INNIS, SPEIDEN & CO., INC.
ESTAB. 1818
NEW YORK CHICAGO PHILADELPHIA BOSTON CLEVELAND
ICCO CHEMICAL CO. H&B BAUTZ CO. WILBUR WHITE CHEMICAL CO.
ICCO CHEMICALS

Innis, Speiden & Co. Exhibit

gauge today of whether a surface is fit for the coating to be applied or not. An instrument has never been devised yet that has not shown the extreme fallibility of human judgment in matters of even the commonest experience.

I should say that well over 75 per cent. of paint failures today are due to lack of adherence. Undoubtedly in most of these cases the surface was simply too wet. We know the tendency of all surfaces is to condense or absorb moisture. How much condensed moisture can a surface hold and still give good adherence

We have a good start in the development of instruments for measuring the hiding power of paints, which property determines the minimum coating that should be applied for complete hiding of the underneath surface. We have a proposed instrument, the film gauge, which is still in development, that is designed to measure the thickness of a coat of paint that is being applied. This latter measurement has become extremely important with the advent of the spray gun.

The conversion of the liquid or plastic film to a coherent plastic or solid is again a matter on which neither qualitative nor quantitative data are available. We not only know nothing of the mechanics of hardening, but do not have any instrument to measure, or any idea to follow as to how plastic or how hard the film should get under a given degree of exposure. We speak of flats, eggshells and gloss finishes, but each of you knows the meaning of the words depends entirely upon the user.

The glarimeter, an instrument developed for the paper industry, has been suggested for the measurement of the degree of gloss, and we have found this quite satisfactory.

Another instrument along the same lines is in process of development by Dr. Pfund. The rate of hardening or increasing of solidity factor of a film can be measured by passing gases of different compositions and different temperatures through the paint or varnish, and taking the curve of increasing consistency. Some work has been done along this line, and we are taking it up anew in the Palmerton Laboratory, but both the instrument and the calibration to actual wear requirements await considerably more work. It is a common expression to say one paint is too hard and another too soft, but what is meant by these terms no two of us could agree upon.

The first detailed report of tensile figures on paint and varnish films has just appeared (Nelson, Proc. Amer. Soc. Test. Mat., 1921). With this carefully worked out method of test it is now possible to explore the whole field of film physical characteristics. Rubber technology absolutely rests for control on the tensile testing machine, and I see a very close analogy between paint and rubber in their life requirements.

In the matter of the study of the life of paints very valuable work has already been done by the various agencies that have carefully exposed test fences and recorded the results. While the findings of these test fences have been highly useful, the development of a technique of life test that could be applied in a reasonable time has been entirely neglected.

A flexible industry like that of protective coatings is tremendously handicapped by such a time factor to determine quality.

The development of the tensile methods of test simply wait on the calibration of the artificial ageing tests before they constitute a fairly complete method of life diagnosis. That is to say, the curves of tensile properties of the film through an artificial ageing period will surely tell the story provided we at the same time can test for the life of adherence.

The ultra-violet lamp, humidity and temperature control are now well developed laboratory agencies, and all that is needed is the undivided attention of a group of workers in this field for a few years, and we shall have accomplished another important step in man's conquest of space and time.

In conclusion I want to ask your indulgence for another harping on the same old string. The outline that I have given may not be the only program to successful development, but it is at least a program. If we paint technologists can agree on our present bearings, and then hold the course due west, our measure of service to the world will be far greater than we can hope to obtain by drifting on the tides of expediency, and at the mercy of the winds of circumstance.

## WASTE IN VARNISH PLANTS

*By Paul W. Webster*

Chief of Industrial Research of the National Research Council

Waste in varnish plants may be of many kinds and may comprise a multitude of sins. In view of the short time allotted, I shall confine my remarks to those arising from the physical character of the plant.

The varnish boiling point of today exists practically unchanged, except in minor details from the form of many generations ago, pretty much as our fathers and grandfathers and their grandfathers built it. Characterized by its massive and costly brick stacks, it is draughty and cold in winter, and a place usually of poor lighting, filled with fums and odor and grimed with smoke. Such conditions mean waste.

Waste of money in the costly stacks.

Waste in the extra human effort expended when working under such conditions.

Waste in the ground space covered by one-story buildings, and the cost of moving materials horizontally instead of vertically by gravity.

The inability to insure such plants at all because of the excessive fire hazard or the high premiums charged is again a waste.

The losses in manufacture run from 5 to 40 per cent., and even higher, of the raw materials purchased and used, and amount to very large sums annually.

These wasted materials pour out through the brick stacks, depositing gummy accretions which must be burned out, to pollute the neighborhood, and with increasing frequency are the cause of complaint, with threatened damage suits or closing of plant, again causing a waste of time and energy.

All these wastes are in whole or part avoidable, and may even be turned into a source of profit.

In the spring of 1916 the U. S. Gutta Percha Paint Co. of Providence, R. I., was confronted with the problem of either abating the nuisance caused by fume from its varnish plant drifting across the street into the windows of a large modern hospital, or closing down its plant.

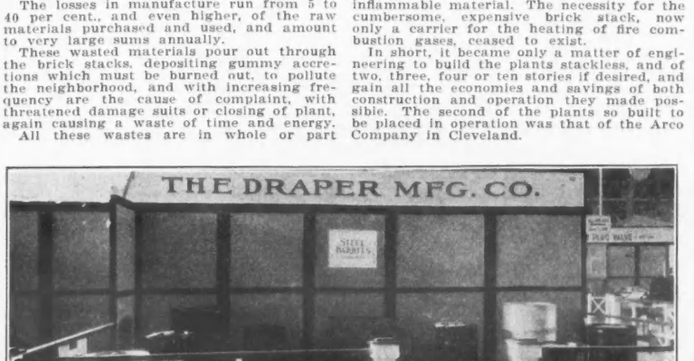
The problem being presented, it was approached in the laboratory along lines indicated by previous successful work in fume and odor suppression, and solved.

Following this, apparatus was designed and installed, and in January, 1917, the plant was put in operation under control for fume and odor.

It was only after over two years of observation and study of this plant that any real effort was made to acquaint the varnish making public with this system. Today engineering designs for the equipment of over a dozen old type stack plants have been made.

Naturally, improvements suggested themselves, and it was found that the fire hazard had been reduced to the normal risk of inflammable material. The necessity for the cumbersome, expensive brick stack, now only a carrier for the heating of fire combustion gases, ceased to exist.

In short, it became only a matter of engineering to build the plants stackless, and of two, three, four or ten stories if desired, and gain all the economies and savings of both construction and operation they made possible. The second of the plants so built to be placed in operation was that of the Arco Company in Cleveland.




Draper Mfg. Co. Exhibit

## RUST: ITS CAUSE AND PREVENTION

*By Maximilian Toch*

Rust and rats are the two greatest enemies of modern civilization. Rust can be prevented, by scraping and painting at stated intervals, provided it can be easily gotten at. As an example of this, the steel and iron bridges throughout the world can be cared for so that their life is infinitely prolonged. One notable exception, however, was the almost fatal case of the rusting of one of the cables of the East River Bridge, where, through politics or otherwise, men were employed who were incompetent and unskilled for the work intended.

Properly painted steel encased in rich concrete would last forever, but steel that is in contact with a concrete in which the Portland cement is exceedingly small, as, for instance, in a 1-3-5 mixture, and where concrete contains large stones which cause voids, or where the mixture contains too much water, is likely to become corroded, contrary to the belief of most engineers.

Prof. J. Newton Friend, of the Municipal Technical School, Birmingham, England, in an advance copy not yet published but to be released October 3, 1921, sets forth a new theory on the corrosion of iron which is scientific and deserves most careful consideration, as does all the work which Prof. Friend has done on this subject. Briefly stated, the new theory is as follows:—". . . starting by the formation of colloidal ferrous hydroxide which by contact with the air flocculates to hydrated ferric hydroxide, which latter is alternately reduced by contact with iron and oxidized by contact with air, thus continuing the corrosion and the production of rust."

This theory, however, does not explain the statements which I propounded in 1906 on the rust in the New York subway, and in 1911, when I examined the remains of the battleship Maine in Havana harbor, which indicated that rust is not always a ferrous or ferric hydroxide, but that it may be of the magnetic type of ferrous oxides, and that the percentage of water is variable, depending, I assume, on the condition of the composition of the steel itself.

I am also glad to note his corroboration that weak alkalies beyond a certain concentration produce rust, and by no means prevent it.

The work of Heyn and Bauer in 1908 proved the corrosive influence of various salt solutions on iron in exceedingly dilute solutions. Lime, which is supposed to be one of the best inhibitors of corrosion, is really a corrosive in lean concrete, and I quite agree with Prof. Friend that the previous theories have not thrown much light on this particular subject, nor have they fully explained the cause of such a reaction.

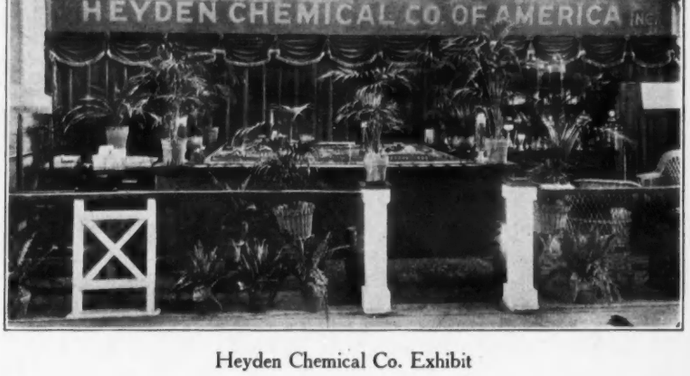
While it is possible, as I have said, to protect steel where you can reach it, there are many places where steel is used where some other metal should be substituted.

On February 9, 1920, New York city was visited by a storm which was the most furious and deposited the greatest amount of snow since the blizzard of March 12, 1888. On one of the canopies in front of a large theatre on Broadway near Forty-seventh street the snow and ice had piled up to a tremendous depth, the steel rods which were supposed to have had a safety factor of 4 could not support the load, and the glass and metal canopy collapsed, killing and injuring, I understand, several persons.

I did not examine these steel rods after the collapse, and frankly admit that I am quoting from hearsay, but in the building of a canopy the same theory applies as it does to bridge building—that the principal factor of safety is to build it strong enough to support itself. Any additional weight counts for very little, and while a canopy weighing several tons can be normally supported by two 1¼-inch square steel rods, they must not be allowed to rust at any point if they are to perform the function for which the engineer intended them.

I mention facts like the foregoing to show that it is perfectly possible by means of paint and rich concrete to prevent corrosion, but our great problem is the prevention of corrosion in boiler tubes and steam pipes, for which, up to now, we have no remedy. If a weak alkaline solution would prevent corrosion, it would be the simplest thing to add to boiler water in steam-heating plants an alkali which does not prime or froth, but the addition of any alkali thus far has produced more corrosion, and I recall seeing sections of two-inch steam pipes in the Hotel Ansonia in New York which were so badly corroded on the interior that water poured in at one end would barely trickle out drop by drop at the other end.

I hope that the new theory of Prof. Friend will give us a remedy.




Heyden Chemical Co. Exhibit

## THE IDEAL PAINT OR VARNISH SPECIFICATION

*By F. P. Ingalls*

In discussing the ideal paint or varnish specifications it is, of course, understood that the ideal or perfect specification cannot actually be written until the sum total of our chemical and physical knowledge shall reach the infinite, yet it is wholly rational to discuss such an ideal and, by overcoming the obstacles one after another, try to approach continuously nearer to it in practice.

Although the larger part of the paint and varnish sold in this country is purchased ultimately by a large number of relatively small consumers, without any specification other than is implied by the brand or assurance of the manufacturer, there are many buyers who, by virtue of some obligation to purchase at the lowest rates or to avoid favoritism in awarding contracts, must accept the lowest obtainable quotations for satisfactory goods. Under such circumstances it is obviously necessary for the buyer to state in clear and unmistakable terms just what goods will be satisfactory or acceptable and at the same time exclude all other or inferior goods. Such a description is called a specification.

The most nearly perfect specification is that one which in the fewest words best describes the desired paint or varnish so clearly and completely that no inferior product can gain acceptance. The ability to write any such specification not only involves a general knowledge of the possibilities of production from such materials and by such methods as are known to be available, but it also implies the existence of ways and means of determining the probable economic value of the delivered goods before they are put into actual service. In other words, the specification must be based on a knowledge of what can be produced and how to test the delivered goods. This is fairly evident, because in any exchange of goods for money or other value the delivered goods must in general be accepted and paid for long before they shall have demonstrated their value in actual service.

It is scarcely to be expected that any one person can have at his command all the knowledge necessary for the best possible specification, nor that a specification which embodies only the knowledge of one person, however expert, will be universally acceptable. In this country, however, we are fortunate in having at our disposal the collective knowledge and co-operative work of Committee D-1 of the American Society for Testing Materials, a committee numbering about 115 members composed of the leading paint and varnish technical experts, producers and consumers both having about equal representation. The A. S. T. M. is a permanent organization of about 3,000 engineers and technical experts, and its prime object is to prepare specifications and to define standards for engineering materials of all kinds. Any specification issuing from such a body may be regarded as highly authoritative.

A number of other bodies are closely allied with it, especially the U. S. Government Interdepartmental Paint Specification Committee, the Paint Manufacturers' Association of the U. S. and the National Varnish Manufacturers' Association, all of which have direct representation on Committee D-1. With all this aggregation of talent operative for a number of years past, it is pertinent to ask, Why are so few complete and satisfactory specifications for paint and varnish available at the present time? The answer to this question brings before us a realization of the really formidable array of obstacles encountered, and the large amount of slow, tedious and painstaking work required to overcome them.

Theoretically paint is a very simple thing. It is merely a solid-liquid two-phase physical system composed of any finely divided, essentially inert powder or pigment, suspended in a liquid vehicle which possesses the property of becoming solid upon extensive exposure to the air. In detail, however, it is no such simple thing, but is, on the contrary, a highly complicated affair with almost infinite possibilities.

The complete list of products of any of our larger manufacturers will show all the way from 300 to 600 or more items, each regularly carried in stock ready for delivery to the purchaser. In addition to these there may be several thousand formulas for special paints or varnishes of one kind or another especially adapted to some unusual or peculiar use. Fortunately, these items, although distinct in themselves, may be divided or classified into about fifteen or twenty groups, or lines, of paints and half a dozen classes of varnish, the individuals of each class differing from one another merely in some minor detail, such, for instance, as color. In a system of classification the difference between the individuals would generally be determined by the pigment present, but the classes would be distinguished by the character and proportion of the vehicle.

Paints are, therefore, usually divided into two grand divisions—namely, paste paints, which require thinning down for use, and liquid, or ready-mixed, paints, which are already thinned down and are practically ready for use. In the first division the proportion of vehicle is as small as is practicable for the grinding process, while in the second division the proportion of vehicle is much larger and is adjusted so as to give the finished paint the required working properties under application. In both divisions the classification rests almost wholly on the quantity of vehicle present and not at all on the character of the pigment.

Although it is desirable that we should have good specifications for paste paints as well as for liquid paints, yet, inasmuch as the paste paints must in general be thinned down before use and in this process may be diverted into any one of several different subdivisions of the liquid paints, according to the character of the thinning liquid, it is only natural that the greater interest should center in the finished paints themselves, and it is these finished paints which not only command the greatest interest, but also present the greatest obstacles to standardization and specification.

In theory the pigment of a paint is supposed to be essentially inert chemically, as

# "CHIRIS"
# ESSENTIAL OILS
AND
# SYNTHETIC AROMATIC CHEMICALS

Many of the products which we offer on our list are manufactured in our American Works in Delawanna, N. J.

As we are in close communication with original sources of supply in many parts of the world, we receive frequent shipments from foreign ports, of materials, not produced in this country.

**VANILLA BEANS**—We supply Bourbon Beans from the Comores Islands, grown and cured in accordance with the best known methods. We offer standard qualities at attractive prices.

**CAPES-VISCOSE**—These self-fixing, air-tight, bottle caps, are now being manufactured in America. We are the sole selling agents.

Send us one of your bottles. We will return it capped, and will be pleased to quote on your requirements.

LONDON, ENGLAND
GRASSE, FRANCE
BAUS ROUX, FRANCE
BOUFARIK, ALGERIA
CHUNG KING, CHINA

MARQUE DE FABRIQUE · AC · TRADE MARK

PARIS, FRANCE
REGGIO, CALABRIA
MESSINA, SICILY
CAYENNE, GUIANA
HAIPHONG, TONQUIN

## ANTOINE CHIRIS COMPANY
ESTABLISHED IN GRASSE, FRANCE
1768

147-153 WAVERLY PLACE - - - - NEW YORK

# JACQUES WOLF & CO.
*Manufacturing Chemists and Importers*
PASSAIC, N. J.

## SIZING AND FINISHING PRODUCTS
## for COTTON, WOOL and SILK

**Bensapol**
Efficient Wool Scouring Agent

**Boil-Off Oil**
Replacing Soap in Degumming Silk

**Bleaching Oil**
Kier Boil Assistant

**Textile Gum**
For Fabric Printing

**Hydrosulphite**
For Stripping and Discharge Printing

**Indigolite**
For Indigo Discharge

**Mordants and Chrome Colors**
For Fabric Printing

**Gums**
Arabic, Karaya and Tragacanth

**All Sulphonated Castor Oils**

Soluble Oil — Turkey Red Oil — Alizarine Assistant

**MONOPOLE OIL**
Reg. Trade Mark No. 70991

Visit our Booths No. 828-830-832—Seventh National Exposition of Chemical Industries
8th Coast Artillery Armory, New York—Week of September 12th

regards the vehicle, the paint being a plain mechanical mixture of finely powdered pigment with a more or less viscous liquid. In the majority of paints, however, this condition is not immediately realized, because nearly all of the available vehicles contain organic acids in varying degree and kind, and many of the pigments are basic in character, some of them highly so. Under these circumstances a certain amount of chemical reactivity is to be expected, especially under the frictional heat of grinding.

Pennsylvania Salt Mfg. Co. Exhibit

From the purely scientific standpoint this does not impair the validity of the theory, for if the new substances formed by the reaction are soluble in the remaining unaffected vehicle, then they become a part of the liquid phase, and if they are insoluble they become a part of the solid phase, so that finally we have a pigment and vehicle which can no longer react with each other. The important point to be considered here is that the resultant paint may, and generally does, have notably different properties from what it would have shown had there been no reaction; furthermore, sometimes these differences may be advantageous and at other times disadvantageous.

In most cases the pigment and vehicle are so chosen that the reactivity shall be relatively very small and fairly constant, but if not so chosen and if the reaction becomes extensive, either at once or during a considerable time, then the paint generally becomes useless, especially on storage. These, however, are not the only complications due to the pigment.

Aside from anything which may be traced directly to chemical reactivity the pigment may have a profound influence in other ways for which, up to the present, there is no tenable and comprehensive theory. Such influence may best be shown by citing illustrative cases. Good raw linseed oil exposed in a thin film will dry in five or six days at ordinary room temperature. The same oil after the introduction of dryers may be made to dry in seven or eight hours under the same conditions; such an oil is readily obtainable commercially as "boiled" oil and in the trade is a fairly definite product.

There are several hundred pigments in common use representing about forty or fifty different types of kinds which differ widely both chemically and physically. When these are ground into paste paints with either raw or boiled oil we notice that while the drying time of the oil remains unchanged in some cases there are other cases in which it is accelerated and still others in which it is retarded. We shall quote only a few of the extreme cases.

Knowing, as we do, that small quantities of certain metals such as lead, manganese, cobalt, iron and a few others have a pronounced catalytic effect in accelerating the oxidation of oil, we are not particularly surprised to find that such pigments as white leads and umbers accelerate the drying speed, nor is it necessary to postulate anything further than a slight chemical reaction between pigment and vehicle to account for the acceleration. No such explanation, however, will account for the great retardation induced by such pigments as vandyke brown, various carbon blacks and certain coal-tar dye lakes made by precipitating basic dyes with tannin.

It is difficult to imagine a pigment more inert chemically than the carbon black made by burning natural gas, and when oil in the boiled oil it makes a good practicable paste with about 12 pounds of black to eighty-eight pounds of oil. Good carbon black gives an ash of less than one-tenth of 1 per cent. and contains occluded air sometimes to the extent of several per cent., but whether or not this occluded air is wholly displaced by oil in the ground paste, it is quite certain that any effect which either the air or the trace of mineral matter might have would be accelerative rather than retardant.

Whatever might be expected as to the drying speed of such a paste paint, the fact is that twelve to fifteen days are required instead of the seven or eight hours required for the oil alone. If the drying time were retarded to only five or six days, it might be explained on the assumption that the metallic dryers are absorbed by the finely divided carbon and their catalytic effect suppressed, but when the paint requires six or eight days more than raw oil itself, no such assumption is tenable. The different blacks owing their color to carbon do not all show the same degree of retardation, but no sort of chemical analysis reveals any sufficient reason for the observed differences.

The most extreme case of retardation coming under the writer's notice was a "tannin-methyl violet" lake ground in raw oil; it did not dry in five months, and even when it could finally be touched was as gummy mess wholly unlike a good paint film. Fortunately lakes of this kind are unimportant, because better ones can be made, and at best they are too fugitive in color for general use, but the case is of considerable academic interest.

## *Influence of Pigments on Durability*

Pigments also differ widely in their influence on the durability of paints made from them. This is especially important in exterior paints, or common outside house paints well known and familiar to almost everybody. Whether this influence is a direct result of the same fundamental principle that affects the drying speed or not is open to question, but there is apparently some close connection, because long experience shows that some of those pigments which exhibit the greatest retardation also have the greatest influence in delaying the decay of the vehicle in service. Other factors probably enter, for it has long been known empirically that if small quantities of colored pigment be added to any given base white paint, the tinted paints so made will outwear the original white, and the hiding power is also increased to a much greater extent than would be expected from such a small quantity of color.

A small instrument devised by Dr. Pfund of Johns Hopkins University allows us to measure this hiding power, and in a research bulletin issued from the laboratory of the New Jersey Zinc Co. on August 1 of this year some results obtained by Dr. Pfund are set forth in detail. Among these results he shows that in a certain paint made from zinc oxide the addition of a very small quantity of lampblack raised the hiding power of the paint from 145 for the straight white to 486 for the light pearl gray tint, these figures expressing the hiding power in terms of square feet of black surface completely hidden by one gallon of paint. The proportion of lampblack required for such a tint is not more, and generally less, than one-tenth of 1 per cent. on the zinc present—a quantity apparently out of all proportion to such a result.

If any such demonstrable resistance to the passage of the visual rays of light follows the introduction of such small amounts of color, it is highly probable that the actinic rays are also obstructed and their influence in hastening the decay of the vehicle considerably diminished. This seems to be the most reasonable hypothesis, for it is fairly certain that actinism and water are the most potent causes of decay in exterior paints.

Whether paints be regarded as merely decorative or protective, or both, their durability as an economic factor is of paramount importance. No extended argument is necessary to carry conviction on this point for, on the average, it is fair to say that $3 worth of labor will be required to apply $1 worth of paint. The initial cost of the paint is to be considered, of course, but the real measure of value is the consumer's ultimate cost for continued upkeep, including the labor charges, and ultimate economy is clearly dependent upon the durability of the paint.

## *Influence of the Size of Pigments*

One other important influence of the pigment must be noted, and that is the effect due to the mere size and shape of the particles. Mixtures of pigments with any paint vehicle do not take on the physical properties characteristic of good paint until the particles present a relatively large specific surface to the liquid vehicle. Roughly speaking, the particle diameter may range from 0.2 micron to 50 microns, with a mean average of 5 to 20 microns. When pigments are reduced by any process of mechanical grinding, the particles are far from uniform in size, and if the material is subject to cleavage, the diameter in one direction may be much larger than in another, so that in stating average size we do not give a full idea of the physical state. It makes a great deal of difference whether there is a wide range between the maximum and minimum size, or whether the particles are more nearly uniform.

The important point to us now is that as the particles become finer the tendency to flocculation increases, and, unless counteracted by the dispersive power of the vehicle, all sorts of changes in the consistency and applicability of the paint may ensue. However interesting the further discussion of this phase of the subject might be, we are concerned here only with the relation of such effects to the preparation of specifications, and enough has been said to show that they alone would render difficult the full description of a paint by merely specifying the ingredients and their proportions.

Whatever the difficulties arising from the pigment, those arising from the vehicle are quite as great. There is no practical vehicle composed of a single unitary substance of fixed properties, and rarely if ever is the vehicle of a finished paint composed wholly of any one of the drying oils in its original state; almost invariably metallic dryers must be added, and while our knowledge of some of them is satisfactory, we know much less about those which have been prepared by the various cooking processes in common practice.

Even linseed oil itself comes to the paint manufacturer in no fewer than five types—viz., raw, refined, boiled, bodied and blown—all in daily use, and when we consider the cooked and uncooked mixtures of the various drying oils with other substances whose chemistry is even less definitely known, we are forced to realize the essential hopelessness of attempting to describe them in terms of composition.

If then such obstacles to full specification by composition are interposed by both pigment and vehicle, what are we to do The answer to this question is easy, but the preparation of a good specification founded on this answer is more difficult. If we consider paint from the consumers' standpoint the composition is of no great moment except in so far as the presence or absence of some particular ingredient positively adds to, or detracts from, the economic value of the paint. The consumer buys paint for what it will do and if he can rely upon a definite performance in service his further interest is perfunctory. We may write a good specification therefore by stating what the paint shall do, knowing of course that such a paint can be made, and the only real obstacle to this procedure is that we have no trustworthy test that will indicate with reasonable certainty the probable durability of the paint in service.

## *Five Chief Properties of Value*

Experience shows that the value of paint rests chiefly on five main properties—namely, color, degree of gloss, hiding power, working properties and durability, all physical attributes. All these, except durability, are susceptible of quantitative measurement, and if we could measure durability, we could determine the economic value of such paints without knowing anything about their composition.

When Committee D-1 first began its systematic study of paints it quite naturally attacked the problem from the chemical side on the reasonable assumption that if the composition were fixed the physical properties must also be fixed. Some of the reasons why such a method could be only partly successful have been given above in considerable detail. The committee soon realized that the subject was complicated, and in order to simplify matters confined its attention for some years chiefly to one type of white paint.

On the Arlington test fence alone some 240 white paints were tested out in which the differences were due chefly to changes in the proportions of the more common white pigments while the vehicle was maintained as nearly constant as possible. Supplementary tests of a similar kind were carried out, literally in thousands, by individual interests, but in spite of every care and an enormous amount of work, the knowledge derived has not been considered enough to serve for a satisfactory specification. The more recent efforts therefore have been directed more toward a study of the important physical properties, and the present tendency is to demand certain physical properties in a quantitative degree, putting up to the manufacturer the problem of how to get them in.

Specifying varnishes by composition has met with the same obstacles that pertain to paint. Until very recent times the attack has been from the chemical side despite the fact that our chemical knowledge of even the raw materials involved is incomplete, meager, and sometimes even no more than speculative. Varnish is simpler than paint in that there are no complications due to pigment, but when two problems are both beyond our capacity to solve, it makes little difference which is the more complex.

During the war large quantities of varnish of maximum durability were required and there was great need for some test which would give some indication of the durability of the many brands offered. Under the stimulus of this pressure a method of test was developed from an idea that has been regarded as axiomatic in the varnish industry for generations. No gum-and-oil varnish yet made has anything like the durability of a first-class linseed oil paint in which the vehicle is practically all linseed oil with only the minimum proportion of dryers, and as the proportion of gum in varnish increases, the elasticity and durability are diminished.

It has always been held that finishing varnishes which are required to withstand exterior exposure should always be "long in oil" and that elasticity and durability were accompanying features more or less in direct proportion. After thorough drying, short-oil varnishes crack readily when sharply bent, and therefore if we add more gum to a long-oil varnish until it cracks when bent we have a measure of the "length" of oil, and consequently the probable durability. This test is the so-called "Kauri Reduction Test" and for the detailed method of carrying it out we must refer you to the latest Inter-departmental specification for spar varnish.

Whatever the further development of this test may show, it is founded on many years of solid experience, and while its results may not run exactly parallel to the service tests in all cases, yet as a test it is less liable to error than the service tests themselves unless the latter are carried out with most unusual care.

For some time yet it may still be desirable to include in varnish specifications the composition desired so far as that composition can be determined by analysis with reasonable accuracy, but by specifying what the varnish shall do and expressing it in terms which our present knowledge can measure quantitatively we are taking a long step ahead.

During the past five or six years in which the attack has been active from the physical side much more progress has been made than in any previous similar period. Work is now under way which we hope will result in an accelerated test for durability in paints, and if this hope is realized the future is rosy with the optimistic expectation that, while we may not indeed reach the ideal, yet, for the first time in the history of the industry, we shall be able to standardize with reasonable accuracy the more important types of both paint and varnish, and write specifications which will be rational, sound and useful.

# LIMITATIONS OF STANDARDIZATION IN PAINT AND VARNISH MANUFACTURING

*By D. A. Kohr*

It is well perhaps at the outset to endeavor to define or to limit the term standardization as used in this paper, and thus lessen the likelihood of misunderstanding of the subject under discussion. An illustration that will be more or less familiar to all of us may be helpful for this purpose.

An automobile manufacturer recently stated that if two or more new automobiles of a certain make were dissembled the parts of these cars could be mixed and then again assembled into the same number of cars without taking any pains to put in any reassembled car the same parts that were together in it originally and that the reassembling operations under such conditions would present no more difficulties than did the assembling of the original cars. Such parts can be used interchangeably, and this is because they are standardized; that is, all parts for any one particular place or position are made from a definite composition of metal milled and machined to certain standards.

It may therefore be said that standardized automobile parts differ from parts that are not standardized in at least two important respects. All standardized automobile parts for any one particular place or position are wonderfully similar in composition, form and dimensions, also the result produced or the service performed by any one such part will be wonderfully similar to the result produced or the service performed by any other standardized part made for the same purpose. In other words, standardized automobile parts may be said to be standardized as to their form and composition and also as to the results they will produce.

To inquire whether paint and varnish are or can be satisfactorily standardized in either or both these senses and to set forth the reasons for the conclusions reached will be the purpose of this paper.

There possibly might be some advantages in standardizing paint and varnish in the first of these two senses and in having a definite composition for each paint or varnish that was to be used for any specific purpose; but it will be well to consider what must be done before we can arrive at such a result. There are many specific purposes for which paint and varnish are used, and it will be impossible to consider here each purpose or each product.

Fortunately the same principles govern to a very large extent whether the problem is to design a paint to protect the steel of a large engineering structure or whether it is to develop a formula of a varnish for finishing airplanes. The differences are largely differences of detail only. Hence it will matter little to us which product or which specific purpose may be chosen for an illustration. The painting of frame houses will perhaps serve as well as any for an example of a specific purpose; and house paint can well be selected as the product because it makes up a fairly large percentage of the country's paint output.

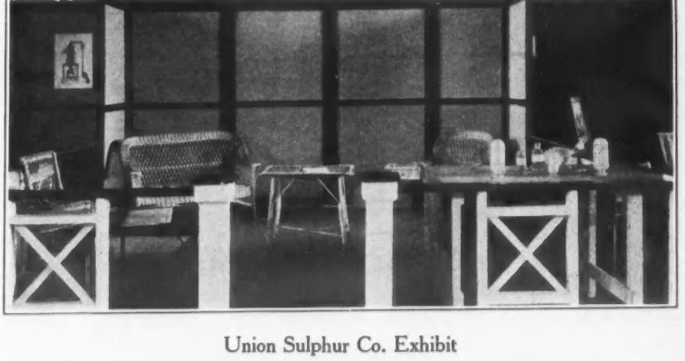
## *Difficulties of Standardization*

When we pass to the next step and endeavor to decide on a definite composition for house paint we find the task more difficult. There are a number of manufacturers who make high-grade house paint. All of them are progressive, striving constantly to improve their products, and most of them maintain research departments for this purpose. But we are confronted with the fact that no two of them use the same formula; indeed, they do not all use the same raw materials, yet each makes a good product. The best authorities in the industry do not agree on the question of formulas or of raw materials.

In view of these facts it may be well to investigate some of the more important properties of high-grade house paints and the requirements they must meet, and then examine briefly some of the methods used to produce paint with such properties. At the same time it should be borne in mind that house paint is here being used as an example of paint and varnish products in general, and what is said concerning it can with only slight modifications be applied to other products of the paint and varnish manufacturer.

Considering these properties, then, in the order in which they manifest themselves to the painter, we have first what may be designated as condition in the package. House paints, like many other commodities, reach the consumer after passing through the hands of jobbers and dealers or merchants. This process of marketing requires time, and since paint is made by mixing finely powdered opaque substances known as pigments, in a liquid that has the property, when spread out in a thin film, of hardening into a solid or a semi-solid substance this mechanical mixture tends to become separated or, as it is commonly expressed, the paint settles. It is, of course, desirable to have a product that shows a minimum of settling, and also one that when it does settle can be remixed without much labor. This property is influenced by the physical condition of the pigments far more than by its composition, and also by the surface tension of the liquid. These are both physical properties that are not checked by a chemical analysis and are not dependent on some particular composition.

Whether a paint works easily or not will often determine whether or not the paint will be selected by a consumer. A manufacturer is anxious to have his products selected, so he pays special attention to their working properties. Satisfactory working is the result of careful treatment of the liquid portion of the paint so that it will be properly tempered for use with the particular pigments it carries. To know the different ways in which this may be done is part of the paint maker's art gained only from the long experience of practical experts who devote their time to thoughtful experiments in the science of paint making. Specifications for a composition that will produce such results cannot be made by others less skilled nor could they be checked by the average chemist.




Union Sulphur Co. Exhibit

It may not seem to be of much importance that a paint should flow out properly, and it is true there are other properties of paint that are more important. But no one likes to see a painted job that when finished shows every mark of the brush; also should a rain storm strike such a job before it is thoroughly dry the action of the rain will tend to wash off much more of the paint than would be the case if it had flowed out properly. In the case of finishing varnishes for some classes of work no property is of more importance than flowing. If the varnish will not flow the fin-

CODES:
Bentley
A. B. C
Lieber
Marconi
Private

# CHAS. PAGE & CO. LTD.

CABLES:
"Paganini"
London

47-51 KING WILLIAM STREET, LONDON, E. C. 4
26 BROWN STREET, MANCHESTER

## Chemicals
For All Trades

## Coal Tar and Ammonia Products
## Fertilizers
## Dyestuffs and Intermediates

PRICE LISTS ON APPLICATION
Offers and Inquiries Invited from Responsible American Houses

Cable Address:
GRAYLIME, N. Y.

ESTABLISHED 1880

Telephone Calls:
VANDERBILT 8990-5

# WILLIAM S. GRAY & CO.

342 MADISON AVENUE, NEW YORK, N. Y.
Canadian Pacific Building

# CHEMICALS AND SOLVENTS

*Manufacturers' Representatives*

Acetate of Lime
Acetone
Acetone Oils
Butanol
Columbian Methanol
Denatured Alcohol
All Formulas

Ethyl Methyl Ketone
Formaldehyde
Hexamethylenetetramine
Magnesia
Para Formaldehyde
Wood Alcohol
Various Grades

CORRESPONDENCE SOLICITED

44 Cliff Street, New York — *Warehouses* — Newark, N. J.

isher cannot use it. A film of paint is very thin, an average uniform coat has a thickness of about one five-hundredth of an inch. Failure of the paint to flow out evenly will result in greater thickness on the ridges, while the paint in the valleys will be thin indeed, resulting in early failure in such places. Flowing, like working properties, is obtained by the proper manipulation of the liquid portion of the paint with consideration as to the kind and amount of pigment with which it will be mixed.

## *Part That Color Plays in Paint*

To most of us the idea of paint at once suggests the idea of color, and certainly the color of a paint is one of its important properties. Of colored pigments there are a great many, varying widely in composition and properties, and a particular shade or tint of paint can usually be produced from any one of a number of different mixtures. To decide which is the best mixture presupposes an intimate knowledge of the properties of all the possible

American Cyanamid Co. Exhibit

combinations and the results they will produce when used as pigments with the particular liquids or vehicle selected to meet the requirements of the paint that is being designed. While there may in each case be some best combination, experts do not generally agree as to what it is; so long as this is the case the problem of standardization presents serious difficulties.

Of importance almost equal to that of color is the question of opacity. We are told the opacity of a paint depends upon the difference between the index of refraction of the pigment and that of the vehicle. This is a physical property that is difficult to determine. The practical method of comparing opacities by applying an unknown sample and a standard paint side by side on a uniform surface answers the purpose very well, when done and judged by one who is expert in making such comparisons. Results obtained by others are not of much value. On account of variations in different pigments and also in different lots of the same pigments used in paint, it is difficult to maintain uniform opacity.

If there is any one characteristic or property of paint and varnish that distinguishes these materials from other products of chemical industry, it is the property possessed by them which we describe by the term drying. Used in this sense the word refers to the process through which paint and varnish pass in being changed from liquid to solid substances; the volatile constituents evaporate or dry off, and the non-volatile drying oils absorb oxygen from the air and in doing so change into a leather-like substance known as linoxyn. These physical and chemical changes do not differ from others in being either retarded or accelerated by the conditions under which they take place; for this reason, while it is possible to design a paint that will dry under very adverse conditions, such a product is not well suited for use under normal conditions.

## *The Problem of Driers*

We know that heat hastens the evaporation of volatile liquids, and hence it follows that the volatile turpentine or naphtha in a paint film will evaporate or dry more rapidly when the painted surface is surrounded by warm, dry air. Likewise the chemical changes that take place in the drying oils when a paint film dries are similar to most chemical reactions in being aided by heat and retarded by cold. Pure linseed oil will dry unaided under ordinary conditions in about a week. When treated by introducing into it in proper proportions compounds of lead, manganese or cobalt known as driers, it may be made to dry satisfactorily in twenty-four hours, or in even less time if excessive amounts of driers are used.

Unfortunately the chemical reactions accelerated by the driers do not stop when the oil film is dry; the oxidation continues until the film has perished as a film, and the speed at which this oxidation goes on has been found to be in almost direct proportion to the percentage of driers present. The manufacturer therefore endeavors to retain in his finished paint as much as possible of the durability of the linseed oil by using in the mixture the smallest quantities of driers that will impart to the finished product satisfactory drying properties.

Opinions differ as to the kind and the amounts of the different driers that should be used to produce certain results, and each manufacturer has developed combinations that he knows from experience will give his products satisfactory drying properties. Since he knows certain pigments hasten the drying of oil while others retard it, the driers added to a paint may be varied in kind and amount, depending on the nature of the pigment. Carbon black or prussian blue will require a different drier from zinc oxide or white lead.

It is generally considered that a linseed oil paint drying hard enough to recoat in 48 hours under favorable conditions will have satisfactory durability. Slower drying paint would be more durable, but it is difficult to get the consumer to wait the 48 hours; in fact, most of them insist the paint must dry in at least 24 hours and that it shall be just as durable as any slower drying product.

## *Question of Durability*

In order to standardize the durability of a paint consideration would have to be given to several questions and conditions determined entirely by the consumer. If he demands a light color he must be satisfied with less durability than he would get if he chose a dark shade. If he decides it is not worth while to go to the trouble and expense necessary to put in proper condition the surface to be painted he should not be too insistent on good results. If he permits his painter to thin the paint to make it work easily and thus save the painter the time and exertion necessary to rub out a full-bodied paint he should look to the painter for redress when something goes wrong, and not to the manufacturer. If he insists on quicker than normal drying under favorable conditions, or if he insists on even normal drying under adverse conditions such as rainy weather or cold temperature he should be willing to accept a proportionately quicker failure of the job. And if he thinks an ordinary laborer is just as good as a competent painter he should not complain if the job goes wrong before it is finished.

These and other conditions that greatly influence the durability of paint are entirely beyond the control of the manufacturer. They are under the control of the consumer, but the infrequency with which this control is intelligently exercised is not very encouraging.

In the consideration of some of the difficulties above described that would have to be overcome in standardizing paint and varnish by specifying their composition most of the illustrations used have applied to paint only. The difficulties that would be encountered in endeavoring to standardize varnish in the same way would be no less, though somewhat different. The general ideas are the same and it will not be necessary to consider here the different properties of varnish.

In the illustration at the beginning of this paper it was pointed out that automobile parts can be standardized because they can be milled and machined to certain standards. Different parts for the same purpose are made from metal of very uniform composition, as it is possible to control the composition within very close limits. Certain raw materials put into the furnace will, when the operation is properly completed, produce metal of certain desired properties.

The paint and varnish manufacturer is not so fortunate in his raw materials. Many are natural products furnished him by nature, and we know all natural products vary in composition and properties. Linseed oil is expressed from flaxseed; it is subject to the same variations we find in wheat and corn or other products of the soil raised in different places and in different seasons. The same is true of tung oil, largely used in varnish making, as well as the other drying oils, all of which are natural products. Gums, or more properly fossil resins, are also important constituents of varnish; they are dug out of the ground and vary greatly, depending upon the depth at which they are found and the geographical locality from which they come. This is also true of the many other natural raw materials such as iron oxides, ochers, umbers, siennas, silica, graphite and similar pigments.

## *Variation of Product*

Even when we consider manufactured raw materials such as white lead, zinc oxide, lithopone and the class of dry colors known as chemical pigments, we find quite an appreciable variation not only in the same product from different factories, but indeed in the same product from the same factory. While white lead and zinc oxide run fairly uniform in composition they will vary somewhat from time to time in various physical properties such as color, tendency to settle, oil absorption and in other ways that influence their action in paint.

This variation is more noticeable in raw materials like chrome yellows, prussian blues, blacks, lake pigments and toners; and in making flat wall paint, for example, it is not an very unusual for the paint maker to obtain from one barrel lithopone that produces a mix so thick it will scarcely go through the mill, and find in the next barrel lithopone that with the same formula makes a mix almost as thin as water.

Very few of the products of the paint maker are made on absolute formulas; it has even been said that paint formulas serve merely as guides, and in large measure this is true, because almost every batch of paint must be modified by the addition to it of small quantities of this, that or the other raw material before the batch is ready to pass final inspection. Accordingly, most paint manufacturers have learned by experience to pay scant attention to the applicant for a position who shows as his chief recommendation a collection of someone's formulas. Almost anybody can mix together raw materials in accordance with a formula, but before the resulting mixture can pass muster as a paint of quality it must be given the careful attention of an experienced paint maker.

The same raw materials from the same sources of supply, as they are furnished to the paint maker, will not when made into a paint always produce a product that has the same properties—in fact, the resulting product is much more apt to vary than it is to be uniform. The consumer expects different lots of the same paint to be uniform and when the difficulties overcome are considered, different lots of the same paint from a reputable manufacturer are wonderfully uniform; but their chemical composition is not uniform within close limits and, if best results are to be obtained, it cannot be made uniform.

The paint and varnish industry differs from the automobile industry, for example, in an important respect. Whereas the automobile manufacturer turns out a product that is ready for the ultimate consumer to use, the products of the paint and varnish maker must first be applied by painter or finisher to some surface owned by the consumer and then be allowed to undergo the chemical and physical changes commonly known as drying and hardening before they can fulfill their real purpose. Hence what the paint and varnish manufacturer is actually furnishing the consumer is not paint and varnish, but beautification of his property, as when a piano is beautifully stained and varnished; or protection to his property, as when an expensive bridge is painted to prevent corrosion of the steel; or both, as when a man has house paint applied to his own residence.

## *Progress in Standardizing*

Since, then, the real value of a paint or varnish is best determined by how well it has produced the effect or the result for which it was designed, the consumer can reasonably ask that such products be standardized as to results rather than as to their composition. And in a general way this has been fairly well done. When a consumer purchases the first grade house paint of a reputable manufacturer he is pretty sure of getting about the same value for his money as he would have received had he purchased any one of a dozen reputable brands of approximately the same price; and this is true of the other important lines of paint and varnish products. To be sure, almost every manufacturer claims his products to be superior to others, but there are so many desirable properties paint and varnish products should possess that some superiority in one of these properties is not so very difficult to attain, if the manufacturer is willing to sacrifice in some other property. For example, we have already considered how he can make his paint dry more quickly at the expense of durability, or he can make it work more easily at the expense of opacity. In fact, almost any improvement in one respect or property is pretty sure to result in a corresponding sacrifice in some other respect for property.

What the paint maker must do is decide which properties are the most desirable in his product and then determine to what an extent he can safely sacrifice other properties in order to produce the results most prized by the consumer.

But the average consumer is constantly expecting more from a paint than the paint maker believes it is reasonable for the consumer to expect. While no manufacturer likes to confess inability to make his product meet all reasonable demands, he is limited by the kind and character of raw materials at his command. He is also greatly handicapped by the fact already touched upon that a number of factors beside the quality of the paint have at least an equal influence on the results obtained from the use of paint and varnish.

The situation is further aggravated by the fact that the average consumer seems to think any conditions under which the manufacturer may specify that his paint should be used need not be complied with unless it suits the convenience of the consumer to do so. But if by reason of unfavorable conditions the paint should fail in any respect, all blame is promptly thrown on the manufacturer, and should he protest, it is at once intimated by the average consumer that the manufacturer is endeavoring to evade his just responsibility.

John Dewar, one of the best known painters in the United States and also one of the best informed, in an address delivered last February before the thirty-seventh annual convention of Master Painters of the United States and Canada, held in Louisville, Ky., made the following statements:—

"I want to state as emphatically as possible that a paint may be scientifically correct and approved by experience, but if not applied in a skillful manner and under reasonably favorable climate and surface conditions, whether it be on new surfaces or in repainting, it will neither protect nor wear, being a failure and cannot be held responsible for the guilt of commission or omission on the part of the painter.

"Seventy-five per cent. of the power of resistance to the ravages of time of a 100 per cent. paint is found in its mechanical application to the surface for which it was designed. This may be a matter of astonishment, but nevertheless a fact, and I am not arguing the question, but stating a truth."

While it is perhaps natural for a property owner to place the blame for the failure of a painting or finishing job on the paint or varnish used, it may readily happen, and indeed in most cases it does happen, that the failure can be surely traced to some cause entirely independent of the quality of the paint or varnish. For example, bridge paint is made to paint steel and not to paint iron rust. If the steel surface is badly rusted and if this rust is not carefully cleaned off before the bridge is painted, a resulting failure in the job should not be charged to the quality of the paint but to the incompetence of the men by whom it was applied.

Fine woodwork is finished to protect it as well as to beautify it. If the wood is improperly seasoned or is damp when finished, the finest varnish will hardly prevent warping or produce a satisfactory finish. This is no fault of the varnish, even though it is usually difficult to prove such is the case. These are truths similar to those referred to in the statements above quoted from the address of Mr. Dewar.

Since the man who applies the product to the surface painted, the character of the surface and the weather conditions are important factors in determining the final result, and also since still other factors of only somewhat lesser importance enter into the question, it would be unreasonable to expect from a standardized paint, if one were obtainable, a standardized result unless it were possible also to control the other determining factors. This would mean among other things the development of a standardized painter, the control of weather conditions and the necessity of always having the same kind of surface to coat.

## *Importance of Surface Preparation*

A vast amount of work has been done by many manufacturers in designing a fairly large number of excellent products which when intelligently used will give fine results. It is therefore not reasonable to suggest that consumers who certainly know less about paint making than paint manufacturers will more quickly bring about the desired end of securing uniformly good results from painting, if they turn their energies from the question of standardizing the composition of paint and give more attention to the control of those factors that have an influence on the final result equal to that of the paint and which are entirely beyond the control of the manufacturer? When a consumer is sure that paint is applied only to clean, dry, warm surfaces under suitable weather conditions, and by mechanics who are fully competent and experienced, then, and only then, can he profitably consider whether he can specify a paint that will be better than the one offered by a reputable manufacturer as the result of his long experience and observation under many varying conditions.

Even if little difficulty were experienced in such standardization, the question arises as to whether it is desirable or indeed advisable. The raw materials are so numerous and the methods of manufacture so varied that the possibilities of development are very great. Hence to standardize certain raw materials in a paint for some definite purpose would immediately tend to discourage search for new and perhaps better materials. An article that by common consent is considered the proper thing to use for a certain purpose tends to prevent the general adoption for the same purpose of something else as good or perhaps better. The liquid portion of an ordinary paint is made up of a mixture of a non-volatile drying oil and a volatile thinning oil or spirit. The two most common of such volatile oils are spirits of turpentine, or turpentine as it is usually called, and one of the petroleum distillates commonly known as naphtha.

Now, if this audience were offered the choice of two paints similar in all other respects but one of them containing turpentine and the other containing naphtha, the chances are that most of you would choose the paint that contained turpentine. The use of turpentine in paint was in a sense standardized some time before modern turpentine substitutes made from petroleum were available. This doubtless explains why the average man is inclined to look upon the use of naphtha in paint as more or less dishonorable, if not really dishonest.

## *The Function of Thinners*

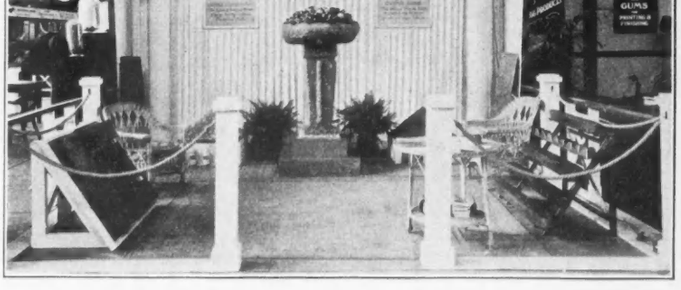
Volatile thinner is added to thin the pigment and oil mixture so a satisfactory coat of paint can be more readily and better applied. The volatile thinner serves no other purpose of any real importance; it does not remain in the paint, but evaporates before the coat is dry. What is required is a liquid that will mix with linseed oil in any reasonable proportion, that will evaporate soon enough after the application of the paint so as not to interfere with its drying, and yet will not evaporate so quickly as to interfere with its proper application. A turpentine substitute properly made from petroleum will do all this as well as turpentine; it is therefore as good as turpentine for such purposes and has the advantage of being cheaper. Of course there are requirements in the industry for which turpentine is better suited than in naphtha, and in such cases the manufacturer will use the material his experience has taught him to be the best for the purpose.

What has been said of turpentine is also true of a number of other raw materials. For a long time white lead was the only white pigment. The introduction of zinc oxide helped the industry by supplying a pigment that for some purposes is better than white lead. Later other white pigments were developed, such as lithopone, sublimed lead and leaded zinc oxides. All have found useful and important places in the industry. But the long use of white lead had so standardized it as a white pigment that it gave place to others slowly; even now there are many painters who think no paint is as good as white lead.

## *Recent Pigment Developments*

Developments in this direction are still continuing; right now still another white pigment is being introduced. It is made from oxide of titanium and promises well in many respects. What has been true in the case of white pigments has also been true with other raw materials. New ones are constantly being offered and it may happen in time that even linseed oil, the most important raw material, will be replaced by some other that can be made to give better results. No one can question that this development in raw materials has greatly aided the advance of the industry; is it wise then to retard further progress of such importance by attempting to standardize paint and varnish raw materials?

This paper will fail in its purpose if it has not convinced you that the manufacture of paint and varnish is a highly technical industry; that the qualities distinguishing really high-grade products from ordinary mixtures of raw materials in certain proportions are




Nichols Copper Co. Exhibit

imparted only by the expert who has spent his life in studying the problems of paint and varnish making; and that in this worthy task he would be greatly hampered by being forced to follow specifications usually prepared by those whose knowledge in this chosen field is of necessity much less than his own. No real workman takes pleasure in making a product he knows to be inferior; he desires to excel, and this desire can find its expression only in efforts to make the product of his hands and brain the best it is possible for him to produce.

You may contend that the consumer should have specifications to protect his interests; certainly no one questions his right to protect his interests, but why not do so by intrusting his needs to the manufacturer who knows best how to produce what the consumer requires? Business integrity is held in as

high esteem in the paint and varnish industry as in other industries, and the consumer need not hesitate to seek the correct solution of his problems from the manufacturer. No paint and varnish manufacturer is in business for a day; he cannot run his factory on first orders only, and he knows he will not get repeat orders unless he gives the consumer full value for his money.

Why then should he be hampered by attempted standardization of his products by those outside his industry? Why not let the industry work out its own problems? Let the consumer devote his energies to making certain that the paint and varnish he purchases are properly applied under favorable conditions and to receptive surfaces. And why not leave the manufacturer unembarrassed in his efforts to attain as his chief goal the continued improvement of his products and the unhampered development of new and better ones?

## EDUCATING PAINT AND VARNISH CONSUMERS

*By Ernest T. Trigg*

Someone once said "Experience is the best teacher." Upon occasion, both appropriately and inappropriately, we repeat this adage. We should be more accurate if we were to say "Experience is the most convincing teacher." But even then we would be only partially truthful, for I believe you will agree that there are other very potent educational forces which, in some cases in our modern society, are more far-reaching than individual experience.

The effectiveneses of experience as a teacher is diminished because of her limitations. Experience may be one-sided and develop in her pupil a distorted, unsymmetrical character. She may repeat the same lesson over and over, in spite of our best efforts, and become not only a disagreeable preceptress, but an inefficient one as well. Upon occasion experience may become laggard and neglect us entirely.

Experience, when she teaches, does so in a most convincing manner. She is convincing because she is realistic; she speaks in concrete terms. And realism and concreteness beget interest and attention.

Besides experience, there is another great educational force of the most far-reaching influence, which we sometimes call "public opinion." Legislatures may deliberate ad nauseam and eventually enunciate a code of behavior affecting the lives of every one of us; but unless the law is backed by public opinion it is impotent—it will not be enforced.

### *The Force of Public Opinion*

We like to assert that we are "free agents," but our ethical and moral relationships are founded largely upon public opinion. In the case where public opinion eventuates in a condition which is beneficial and pleasurable, the combined effects of public sanction and personal satisfaction constitute an almost invincible force. Experience may teach us that a certain action results in slight physical injury, and we may persist in the practice notwithstanding. But let public opinion express itself, and a very brave or callous heart is needed if we are to run counter to its mandates.

Now it happens that public opinion is pliable. Like glass, it can be slowly bended. Where a sudden shock would have a shattering effect, a slow, persistent pressure will product almost any desired result. And the rapidity with which the change can be accomplished will be closely proportional to the degree of truth embodied in the force at work.

This natural law applies as fully in the education of paint and varnish consumers as in the education of any other group. There is probably no commodity more universally used than paint and varnish. Everyone is familiar with it, with its appearance and, in a more or less ill defined way, with its uses. To the esthetic sense paint is a beautifier, whether it be on house or canvas. To the engineer and scientist paint and varnish appeal as surface protectors and conservers of wealth.

I suppose I would be justified in saying that on the average we are not very highly specialized either esthetically or scientifically. But in general we seem to have a greater inherent appreciation of pleasing appearance than we have of conservation of property.

For instance, most people, upon seeing a dilapidated building, will remark as to its ugly appearance, rather than as to the condition of the material structure. We are depressed by a gloomy environment. We are uplifted by pleasing surroundings and harmony of color. It is, therefore, quite natural that the consuming public, which has caused the manufacture of paint and varnish to develop into one of our greatest industries, should have placed the emphasis upon the improved appearance of surfaces covered with these products, rather than upon their protection from decay and attrition. It is only recently that serious consideration has been given by the general public to the great value of paints and varnishes as preservative materials.

If our products were to be used for beautifying purposes only—that is, if there were no need for surface protection—tones and tints would perhaps be the major considerations involved in the manufacture of these products. But when emphasis is placed upon paints and varnishes as protective films, which are really to serve as a shield between our property and the onslaught of the elements, the question of the ability of these surface coaters to withstand attack becomes one of commanding importance.

### *Specializing in Paint Manufacture*

The doctor is successful to the degree that he is specific. And the practice of medicine and surgery has become so complex that to be specific means to be a specialist. The conditions under which paint and varnish must stand up are so diverse that the manufacture of them is attended by a similar high specialization. Paint deserving of the name has to be made according to prescription. The prescription can be determined only after detailed study, not only of the disintegrating forces to which it will be subject, but also of the surfaces to which it will be applied. The demands for and requirements of surface coaters are multitudinous. They are required for preserving surfaces of every conceivable type. They must withstand successfully exposure to a legion of destructive agencies.

Probably no other article of public consumption requires so much reserch and technical skill in manufacture as do modern paints and varnishes. By modern paints and varnishes I mean those which are purposely made, with precision, for specific purposes of the most exacting nature. For instance, the manufacturer of cement selects his cement rock, limestone and coal with a view to a standard quality of cement; the ironmaster gives attention to the character of his ore, fuel and flux purposely to produce a standard quality of steel. These comparatively simple considerations, complicated in special cases by the introduction of a limited quantity of other ingredients required for special purposes, constitute about all that the makers of these two important commodities have need to worry about from the standpoint of raw materials.

Let us look for a moment at the paint and varnish industry. There we have a thousand chemical and earth pigments or colors, oils, resins, thinning liquids and waxes which enter into one or another of the products of this great industry. And each of these must be selected with the greatest care. Furthermore, the properties of each of these many raw materials must be made the subject of extended research in order that it may be used under varying conditions of combination with other ingredients, always in a precise and perfectly effective manner.

Because of these conditions the outer reaches of possibility in the paint and varnish industry have never been glimpsed. Through tedious centuries its technique has slowly evolved. More recently this ancient heritage has been builded upon by intrepid spirits who dared to vision a new era in manufacturing methods. Through the farsightedness of these leaders, surface coaters, made according to specific prescriptions, are now being produced by a number of leading manufacturers.

### *Manufacturers' Book of Scientific Discovery*

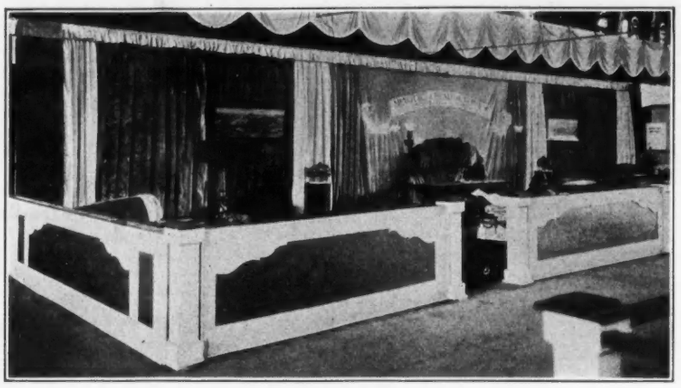
Those manufacturers are always vitally interested in any scientific discovery which has the possibility of throwing light upon one or another of our many difficult problems. As manufacturers we have shared such information with each other. This has been a necessary step in bringing our technique to a sufficiently advanced point to warrant our later steps toward the education of paint and varnish consumers.

As a result of this policy the Paint Manufacturers' Association in 1907 organized its Educational Bureau. In their preliminary study, which was made to determine what initial activities of the bureau would be most conducive to carrying out the work for which it was organized, the members of the bureau became convinced that a policy should be adopted by which information should be supplied not only to the members of the association, but to the consuming public as well. The need was early felt for widespread demonstrations which would call the attention of the public to the economic, as well as to the esthetic value of paint.

One of the earliest activities of the bureau was in connection with the liquids required in paint manufacture. At intervals, for many years past, the industry has been menaced by shortages of the flax crop. Upon such occasions not only legitimate and intelligent attempts have been made to utilize other vehicles, but persons who have been actuated by shortsightedness and cupidity have often taken a temporary profit through the substitution of inferior materials. The close study by the bureau of this condition with all of its ramifications brought to light at least one important and several promising vehicles previously unknown.

There is, of course, attendant upon the introduction of new materials into the industry both a promise for greater achievement, and, in the hands of unscrupulous "oil dopers," a serious menace, especially when the price of linseed oil is high. In the hands of conscientious paint technologists, these new materials provide not only a reserve for emergencies, but also, in some cases, superior vehicles for new paint specialties.

Because of these considerations the bureau in 1911 authorized the erection, on the grounds of the Institute of Industrial Research at



Newport Chemical Works Exhibit

MICCO

Acetate of Lime
Acetic Acid
Methyl (Wood) All Grades
Alcohol
Denatured All Grades
Methyl Acetone
Formaldehyde

Our large production and distributing facilities enable us to give careful attention to all orders and make prompt deliveries.

MICHIGAN IRON & CHEMICAL CO.
220 SOUTH STATE STREET
CHICAGO, ILL.
Plants: BOYNE CITY and EAST JORDAN, MICH.

Washington, D. C., of a vehicle test fence, on which all known paint vehicles are now undergoing practical exposure tests for the purpose of obtaining data which will benefit both the manufacturer and the consuming public.

### *Institute of Industrial Research*

The bureau laboratories are under the supervision of Henry A. Gardner, who is also director of the bureau's scientific section. These laboratories are located in the Institute of

Anaconda Copper Mining Co. Exhibit

Industrial Research, at Washington, D. C. They are quite generally recognized as the best equipped laboratories in the world for research in the field of paints, oils and allied materials.

The bureau early took steps to prevent the threatened abandonment of flax raising in America. As a result of its suggestions, made in 1907 all of the principal paint manufacturers of the country united in an effort to rehabilitate flax raising. A special committee was appointed to have charge of this important matter, with which the bureau has remained in close touch ever since, co-operating with it at every step.

The bureau has not confined its activities to raw materials. It has given much attention to the physical properties of paint films as a necessary prelude to its study of the chemical conditions affecting them. Through this research a number of advanced methods and some new devices have been invented. To facilitate the physical investigation of paint, which in many cases can be best done by a study of separate laminae of paint, an original method has been devised for producing paint films which are easily removable, intact, from the surface upon which the paint has been spread. An effective self-registering instrument for measuring the strength and elasticity of paint films has been perfected. Nitro-photography of paint film has reached a high state of perfection.

In order that those interested might be kept constantly in touch with this pioneer work of the bureau, a large number of scientific treatises relating to various aspects of the paint industry have been published. The work of the bureau has also been given wide publicity through trade papers and engineering and technical journals. As distinguished from its scientific publications, there have been many which are commonly spoken of as "practical," which relate to the use and application of paint. These also have received the widest publicity.

The bureau has also done a large amount of lecture work before technical and business organizations, community associations, and the like, through its practical and technical staffs, as well as through the members of the bureau themselves. In this manner valuable information for paint manufacturers, journeymen painters and the consuming public has been most widely disseminated.

This work has all been done, fundamentally, in the interest of the consumer. The bureau has not developed "trade secrets" for any one manufacturer or for a small coterie of manufacturers, but has made its information available world wide, to all who might desire to use it. I have but briefly referred to some of the more important achievements of the bureau. A detailed account of its work would be too lengthy for presentation here. Its chief appeal has been to the manufacturer of paint and to those technical branches of the construction industry closely related thereto, but the results of the work of the bureau have been transmuted into very definite benefits to all users of paint.

By those methods of operation the bureau has exercised a mighty influence upon public opinion. It has not attempted any far-flung propaganda. It has devoted itself to a genuine effort to give the public a better product for its money. At no time has it resorted to spectacular advertisement of itself. But it has exerted a slow, steady pressure upon public opinion which has educated the consumer to the fact that the paint and varnish industry is a highly developed one, that surface coaters best serve which are manufactured with an aim to specific uses, and that "cure-alls" in paint and varnish are no more possible than in medicine.

Thus has the foundation been well laid for a second great step in the paint and varnish industry. The foundation was laid among manufacturers by the development of an esprit de corps, which has never existed before, and of their appreciation of and pride in superior quality. The foundation among consumers was laid by the development of their belief in the sincerity of those who may be classed as legitimate paint and varnish manufacturers.

Upon this foundation has been built a campaign, with which you are all undoubtedly familiar, purposely designed to influence public opinion. I refer to the great lesson embodied in the slogan, "Save the Surface and You Save All."

### *Save the Surface Campaign*

Unlike the bureau referred to above, the sole purpose of the "Save the Surface" campaign is deliberately to mold public opinion slowly, and hence, effectively.

The "Save the Surface" campaign was launched in the spring of 1919 through the joint efforts of all important paint and varnish interests, including producers and handlers of raw materials, paint and varnish manufacturers, jobbers and dealers in paint and varnish and master painters. The campaign is impersonal. It is impartial. It is not designed to confer special benefit upon any one person or firm.

The campaign is the result of a strong conviction on the part of thoughtful men in the industry that a large proportion of the property in the United States is not being properly protected from preventable wear and decay. In many cases no attempt is being made at protection at all. A rough estimate has been made that not over 25 per cent. of the property in the United States is being painted and varnished with sufficient frequency properly to protect and preserve it.

The 25 per cent. estimate, a more or less arbitrary one, is undoubtedly high. It was made high purposely, in order to be conservative. I feel confident in the assertion that if it were possible to subject the paint repair condition of all the property in the United States to an exact determination, the result would show that less than 25 per cent. is being protected from the action of the elements by proper and sufficiently frequent paint coatings.

Our primitive forefathers seem first to have used equally primitive pigments for decorating their bodies. It was probably long afterward that the idea occurred to them to decorate their tents as well. Thus by slow steps has the art of decoration developed. The tents were not painted for the sake of preserving them from the weather; they were painted to make them look pretty. The great teacher, Experience, has never taught the masses that paint is for any other purpose than that of decoration. She has taught a few scientific souls that so long as a film or paint or varnish is maintained, like a shield between the surface and the forces which tend to disintegrate it, the forces are impotent to destroy anything except the paint film; and that if this paint film is made of a material which has been produced with a detailed understanding of how these destructive forces act, the film itself will wear only very slowly.

In order to get across to the general public the facts which technical experts have learned by experience, the "Save the Surface" campaign is necessary. The results of this campaign will be to mold public opinion into the same conviction relative to surface protection as that held by these technical experts.

The industry recognizes the decorative appeal in paint and varnish, and the great value of their decorative function, both to the individual property owner and to the community as a whole; but it knows that the sound economy arising from the use of these products lies in their protective quality. If a property is left with its surfaces unprotected that property will disintegrate as surely as night follows day.

Packed into the terse slogan "Save the Surface and You Save All," a brief imperative of seven simple words, is the whole reason for the existence of the paint and varnish industry. It is well known that rot in wood and rust in metal are caused by moisture coming into contact with their surfaces. It follows that if all exposed surfaces are completely covered with coatings which are impervious to moisture, the surface of the wood or iron cannot begin to rot or rust. If the surface does not disintegrate the interior is forever safe. The campaign addresses itself to the education of the consuming public on this point.

Large corporations attend to the proper painting and varnishing of their plant and equipment surfaces, and of their products, with as much care as they give to any other phase of operation. The executives of these corporations would as soon think of neglecting fire insurance as decay insurance. This attitude on the part of large business organizations is well illustrated by the attention paid by the Federal Government to its paint and varnish problems.

For example, the specifications by the government during the war for the construction of ships were just as explicit relative to surface protection as they were to any other detail, and were checked up just as carefully. The repainting of these ships, both during and since the war, has been as exact and as regular as any other part of the ship's repair. This condition holds true in all government activities, both in times of war and in times of peace. Large manufacturing plants, under the direction of careful and far-seeing executives, are invariably kept in excellent paint repair. Such executives realize the economy of their policy. They are not at all influenced by the subsidiary decorative feature, which can be incidentally worked in, without additional expense.

The railroads are consumers of what to the lay mind might seem to be fabulous quantities of paint and varnishes. We all understand how great the financial problems of the railroads have been since the war. They have not spent a cent for anything which their executives did not consider to be absolutely necessary. And yet during the years of 1919 and 1920 the railroads of the United States purchased, annually, well in excess of $20,000,000 worth of paints and varnishes. These large purchases were made as a matter of absolute necessity.

These materials were not bought from the standpoint of decorative consideration. They were used for the purpose of preserving and prolonging the life of certain carefully selected equipment, much of which was in extremely bad condition, and which, under ordinary conditions, would have been replaced by new equipment. Here is an instance where paint and varnish were used as the only means of getting further use out of equipment which would otherwise be of little value. There has probably been no group of men more burdened by financial problems during the last two years than the executives of our great transportation systems. Their resourcefulness in the use of paint and varnish is a striking example of the truth which we desire to get across to a hundred and twenty million people through the "Save the Surface" Campaign.

The word "property" refers not only to structures, but to many other classes of capital investment; as, for instance, automobiles, vehicles of all kinds, farm implements and tools, and articles of every nature, whether of wood, metal or other material which come into contact with the elements or other destructive forces.

It is candidly admitted that the "Save the Surface" Campaign was inaugurated and is being carried on with increasing energy and effectiveness by those interested in the industry and in the production and sale of increasing amounts of paint and varnish. The campaign is, however, founded upon truthful promises, and the logical presentation of the truth which it is desired to drive home is slowly moulding public opinion in the right direction.

The campaign is serving a public and national purpose of the greatest importance; it is helping to conserve property values, thereby benefiting the individual, his community and the nation at large. The industry as a whole profits through a widening of the market and the increasing consumption thereby affected, but the purchaser and user benefits many times more than does the seller—for the destruction of property which is not properly protected by paint or varnish is going on constantly, twenty-four hours every day. It is an immutable law of nature that it should be so.

Property owners who fail to insure their property against loss by fire are considered improvident. They are not good credit risks for the banks and the merchants with whom they desire to do business. Banks ordinarily will not extend credit to a man who does not carry fire insurance on his property. And yet, statistics of fire insurance companies show that practically one-half of one per cent. (fifty-year average 56/100 of one per cent.) of all of the risks insured by them are destroyed by fire.

Property owners who fail to insure their property against destruction by the less spectacular, but universal destruction through wear and decay, are facing a 100 per cent. loss. Wear and decay may be slow at first, but it is a well known fact that after depreciation has reached a certain stage, complete destruction invariably follows with great rapidity, in spite of all efforts to retard it.

A favorable reaction by the public to this campaign of education is already noticeable. The response has been far beyond the expectations of the most sanguine. Public opinion is beginning to swing in the direction of property conservation by the use of paint and varnish. The beginnings are noticeable of an appreciation on the part of the public of the sound economy to be derived from surface protection. The public is awakening to the fact that its property is in jeopardy and must be protected if it is to escape destruction.

The campaign has nothing to sell except a conviction. Its arguments are presented to the public through the leading magazines having a national circulation, through trade papers, by individuals in all branches of the industry, by personal discussions with groups of public men, by presentation to community associations and in all other ways possible. The basic soundness of the premise upon which the campaign is founded and the native intelligence and imagiation of the American people are being wonderfully attested by the quick response which is being given to the campaign by the public.

Expensive fire prevention equipment and tens of thousands of men are held in readiness night and day to respond to isolated threats of property destruction by fire. Until recently no concerted step has been taken to protect our national wealth from the slower but inevitable disintegration by natural processes. I mentioned above that it has been estimated that 25 per cent. of the property of the United States is adequately protected by surface coaters. The annual production of paints and varnishes in the United States amounts approximately to $300,000,000. This expenditure is for the protection of 25 per cent. of our property.

The "save-the-surface" campaign is moving inevitably in the direction where public opinion will condemn the man who permits his property to be destroyed for want of proper surface protection. Eventually we shall reach a condition approximating closely a 100 per cent. protection of property by the adequate use of surface coaters. Allowing for the probably high estimate of 25 per cent. above referred to and for the continued growth and development of the country, even an approximation to 100 per cent. property protection will cause the paint and varnish industry of the United States through this great educational campaign, through the slow but steady moulding of public opinion, to assume the giant stature of a business producing well in excess of $1,000,000 worth of commodities annually.

In the meantime the attention of the public and of manufacturers is being focused upon quality of paints and varnishes as never before, and the adventurer who would "get by" with initiation surface coaters is experiencing "considerable hard going." In time he is going to learn from experience, that great teacher, that unless he crowns the arch of his business effort with the keystone of integrity he cannot exist.

## WHAT IS PAINT?

*By G. B. Heckel*

The paint manufacturing industry of the United States was started in Philadelphia over 100 years ago, but up to about three years since, the average citizen believed, when he thought about it at all, that things are painted to make them look pretty.

Some years since I had occasion to submit to the eminent attorney, John G. Johnson, the draft of a proposed paint law, in the first paragraph of which paint was defined and described as intended for preservation or decoration, or both. Mr. Johnson promptly pounced upon this as incorrect. "Paint," he asserted, "is not used for preservation." I asked if he thought the Pennsylvania Railroad, of which, by the way, I think he was a director painted its bridges and locomotives to make them look pretty. But he was not entirely convinced until he had consulted the dictionary.

This erroneous conception of the purpose of painting has now, thanks to the "Save-the-Surface" campaign, been corrected in the minds of a large and constantly increasing number of people. It is true that paint is a beautifier as well as a sanitary agency; but first and foremost it is an agency of conservation. "Save the Surface and You Save All"—and it is this fact, that it saves more money than it costs, that is the true and proper incentive for its large and constantly increasing use.

Now what is this commodity that beautifies while it protects, that conserves invested wealth out of all proportion to its actual cost?

At a recent hearing in which I was called to testify, I was asked the following question:—"Are not white lead and linseed oil the principal ingredients of good paint?" My answer was, "That depends upon what the good paint is to be used." The annual consumption of white lead (not white lead combined with linseed oil, but the dry pigment), is upwards of 100,000 tons. The consumption of lithopone, another white pigment, is also nearly 100,000 tons, while the consumption of zinc oxide in the paint industry is about 75,000 tons. These are white pigments, only the figures show that even among these we have an important consumption in addition to that of white lead.

Any paint manufacturer, and especially any paint technologist, will realize that answer to the question assigned to me is neither simple nor easy—it somewhat resembles the question "what is food?"

Calco Chemical Co. Exhibit

### *Definition of Paint*

The "Paint Catechism" answers the question as follows:—"Any liquid or semi-liquid substance applied to any metallic, wooden or other surface to protect it from corrosion or decay, or to give color or gloss, or all of these qualities to it." Thus far the definition is quoted from Wood's "Rustless Coating." It continues as follows:—"More properly speaking, paint is a mixture of opaque or semi-opaque substance (pigments) with liquids, capable of application to surfaces by means of a brush or a spraying machine or by dipping, and of forming an adherent coating thereon."

The definition of Webster's Dictionary is as follows:—"A preparation of a pigment or coloring substance made by mixing with some suitable vehicle, as oil, water, or varnish, and forming, when applied to a surface, an adhesive coating; also, the pigment or solid coloring matter alone, or a cake of it; as, a box of paints. Paints are prepared variously, often containing driers, as japans and thinners, as turpentine. Paints differ from dyes and stains in not being solutions, and in forming surface coatings which are commonly used to preserve as well as to color. Paint in which oil, especially linseed oil, is the vehicle, is called oil paint. Such a paint usually differs from a varnish in that it dries by oxidation and so increases in bulk, while a varnish usually dries by evaporation and diminishes in bulk."

A lack of co-ordination in the editing of this great dictionary is apparent when we compare with the last clause of the foregoing the corresponding definition of varnish, as follows:—"A more or less viscid liquid (usually a solution of resinous matter in oil or a volatile liquid) which, when spread upon a surface, dries either by evaporation or chemical action, forming a hard lustrous coating capable of resisting more or less the action of air and moisture."

As a matter of fact, we know that a vast preponderance of the varnish consumed dries exactly as paint dries—by the gradual oxidation of the unsaturated fatty acids of the oil vehicle.

While no accurate figures are available it is probable that about 60 per cent. of the annual paint consumption of the United States is on building and other structures and the remaining 40 per cent. on equipment, manufactured products, etc.

One of the Saturday Evening Post advertisements of the "Save-the-Surface" campaign consisted of a list of over 1,000 articles, structures, materials, etc., in or on which paint is used. In this list materials so widely different as wood, steel, concrete, etc., appeared. It is obvious to the most casual thought that no simple definition could adequately describe a material intended for the preservation or decoration of substances so diverse in chemical and physical qualities. Add to this patent fact the further consideration that the conditions of service are as diverse as the materials to be protected and we realize that any adequate answer to the question, What is paint? involves technical knowledge of a wide and varied range. Advancing civilization imposes upon us needs that become more and more varied and complicated.

Up to the middle of the last century paint was used largely as a decorative adjunct, the protection afforded being incidental. Up to that time, also, the manufacture of paint was based on well-established traditional rou-

tine. Practically the only white pigment available was basic carbonate white lead. Practically the only available oil vehicle was linseed oil. Zinc oxide, lithopone, basic sulphate white lead, titanium oxide, China wood oil, soya bean oil, perilla oil, slumbered with the coal-tar colors in the womb of time. So late as 1888, although 33 producers were listed, the total annual production of white lead was only 60,000 tons, while the production of the six zinc oxide manufacturers was 18,000 tons.

In 1812 it is stated that 12 tons of the metal lead produced by the Perkiomen mines at Audubon, Pa., satisfied all the requirements of the country, augmented as they were by the needs of the American army at war with Great Britain.

In such a stage of advancement it is not surprising to learn that the painter ground his own lead and colors and that simple mixture of white lead and linseed oil supplemented by a few natural colors and lampblack satisfied all needs. I can well remember the day when every country paint shop was a miniature paint factory, and men are still living who can remember the day, somewhat earlier, when every painter was his own varnish maker, and the use of both paint and varnish was confined to the dwellings of the rich, who wished to flaunt their prosperity.

Life was too strenuous, materials for replacement were too abundant and the art of the industry was too primitive for any other condition. The Dutch, however, who usually contrived to hit on the vital point of every economic situation, long before that had embodied the high quality varnishes of the world were made of kauri gum.

### *Paint and Varnish History*

The history of paint and varnish manufacture parallels the history of other great industries. First a traditional art handed down from father to son, then a rule of thumb, hit or miss practice stumbling through repeated failures to final success, and finally the advent of the patient research man, and the informed technologist who bring us to the plane of systematic intelligent investigation and carefully controlled and duplicated practice.

Not every paint or varnish plant of today employs a research man or even a chemist, but the knowledge leaks, the example spreads and the entire industry, as well as the consuming public, benefits.

Neither the paint nor the varnish of today have reached final perfection, but year by year these products serve better and better an increasing number of consumers.

If, thirty or forty years ago, the varnish man had been assured that by 1921 the available supply of high grade kauri would be exhausted, or if his contemporary paint manufacturer had been assured that by a certain date the use of his most important pigment would be prohibited, both would have been panic-stricken. But since his day the technical man has been "on the job," and the varnish man of today regards with equanimity the gradual exhaustion of the New Zealand gum fields, while the paint manufacturer of today

Albany Chemical Co. Exhibit

their conviction in a proverb, "Good paint costs nothing," the legitimate ancestor of the slogan, "Save the Surface and You Save All."

### Must Conserve Supplies

Today, after we have depleted our natural resources and come to realize that iron does not grow in the ground nor even trees in the forest unless permitted to do so, we are coming to realize that in lieu of supplies that are not inexhaustible we must conserve those we have or go without. The steel that has disappeared from a railway bridge or plow coulter as rust is gone forever. It is unavailable for the use of man to all eternity. The wood that has rotted or crumbled into dust, is, for human use, as if it had never existed in the forest.

The concrete structure that has dietintegrated through electrolysis of enclosed steel or from the surface action of the elements mingles with the debris of creation, irreclaimable and irrecoverable. But all of these materials and a thousand more can serve indefinitely, practically without deterioration, if systematically and sensibly protected by paint, and in this statement we have the true and complete answer to the question, What is paint?

Paint manufacturers as well as varnish manufacturers are, quite wisely, uncordial to specifications involving fixed formulas as well as to laws which stress the importance of the formula or tend to impose it upon their practice by the inertia of public opinion. Good paint—the best paint for any given purpose—is that paint which, under the conditions of that specific service, best and longest perform its office of protection. The factors that conduce to such superiority are largely physical rather than chemical, and even where chemical, are largely governed by physical conditions. Hence, the most important considerations governing the proper formulation and production of such a paint are physical and, after all, it is generally speaking, the maintenance of the paint in its original physical condition against the attack of physical agencies of destruction that eventually determines its value.

Set a paint technologist the task of complying with a specification—for government war use, for example—and unless he be abnormally patriotic, he will find abundant analysis—proof means of complying with the letter of his contract while evading its spirit, to the advantage of his employer. Set him, on the other hand, the task of producing the best paint he can devise for a specific purpose at a given price, and the result will be infinitely superior. In the one case his task is to make as much money as he can for his house within certain prescribed limits entirely unconnected with service value; and on the other he is put upon his honor as a technologist to produce results. Which attitude of mind would you prefer if you were the buyer?

Neither the paint nor the varnish of today would in any important respect approximate the composition of the corresponding products of fifty years ago—even the white lead and linseed oil are different, and in some respects better. A long list of new pigments, vehicles, etc., unknown or unavailable, before the middle of the last century, have been placed at the disposal of the modern manufacturer, and another, less extensive list of materials once regarded as indispensable, have been exhausted or superseded. What paint chemist of today, for example, would recognize, outside of his laboratory, king's yellow, lapis lasuli, zinc-lead, amber? Yet all of these were of some importance in their day. And what would a paint chemist of 1850, had there been one, have done with China wood oil, lithopone, sublimed white lead, perilla oil or a hundred other familiar modern materials of paint and varnish factories?

It was said of old that durable protective varnish could not be made with rosin. But behold, the durable varnihses of today, many of them contain 66 resin but rosin. Earlier experts maintained the same as to kauri gum, but until the approaching exhaustion of the supply placed the technologists on their mettle knows that paint will continue to be made and used despite the panic fears of the sanitarian and the labor vote fears of the legislators.

The question "What is paint?" is to my mind of less practical importance to the consumer of paint than the question "Why is paint?" The answer to this latter is what he really needs, for the good of his soul and the integrity of his pocketbook. For given the ownership, the investment of his money, in property of any kind, susceptible to preservation by a surface coating, it is vital to him and vital to the conservation of our country's invested capital and its material resources that he should know and realize what paint is for and what it will do. If his clothing wears thin so that it no longer adequately protects his body, contact with the elements will prompt him to renew his covering. But his property has no voice to remind him of its needs. Yet the same elements which would destroy him if his body were not constantly armed against them will even more surely destroy his investment if it be not as carefully and constantly protected.

I have little patience with the propaganda for or against this or that paint material or paint formula when I know that billions of dollars of American capital are crumbling into the dust bin while the protagonists wrangle.

All honest paint is good paint, and the worst of it, with special exceptions, better than no paint. Take from the resources of the manufacturer and the ultimate consumer of the consumer the 65,000 or 80,000 tons of zinc oxide, the 30,000 or 50,000 tons of sublimated white lead, the 85,000 or 100,000 tons of lithopone, yea, even the 100,000 or 125,000 tons of inert pigments, barytes, asbestine, etc., annually consumed in the paint industry; take away from him and from the varnish manufacturer the vast imports of oriental oils, and you would doom much valuable property to certain destruction in the near future. If the paint manufacturer can make, as we know he can, highly serviceable paint out of any or all of these materials, he is doing well his "bit" in the service of civilization.

What we need in this industry is a wider vision, backed by better team work. Competition, yes, it is a necessary curb on our predatory instincts, but not the competition which settles differences with a club while the consumer waits; not the competition in which the consumer is beaten to death between the two contestants. While the doctors are disputing the patient dies—while the harvesters are trampling down the grain in one field the grain in the next is nipped by the frost.

To the members of the paint and varnish industry, if any, in this audience, I say, you are asleep at the switch, wrapped in a megalomaniac's dream. Not in a thousand years will you alone, even the greatest among you, accomplish in the broader fields what can be accomplished by fifty of your smallest competitors working along unselfish lines for the general good and pooling their energies and resources to that end.

In the Acts of the Apostles we are told of a vision in which a certain man of Macedonia appeared with the plea, "I pray you, sirs, come over and help us." The property-owners of this country are mostly, though they do not realize it, in the position of the men of Macedonia—they need help which can come to them only from the paint and varnish industry. For their good, for the protection of their investments and for the conservation of our national resources, you paint men have an apostolic mission, a social obligation, first to convince them of their sin of neglect and, secondly, to turn them from the error of their ways. The means are at hand. Will you do your duty?

I think we are now prepared to answer sensibly, if not technically, our original question, "What is paint?" My answer—perhaps you can give a better one—is this: The protector of tangible investment; the conserver of natural resources.

Half a dozen one and two-reel motion pictures were shown in connection with the paint and varnish program. They depicted manufacturing operations in white lead, paint and varnish, and were shown through the courtesy of the National Lead Co., the Murphy Varnish Co., the Sherwin-Williams Co., Lowe Bros., and Taylor, Tregent & Co., in conjunction with the Bureau of Commercial Economics.

# FRIDAY

A meeting of the American Ceramic Society was the first thing on the Friday program. It began at 2 o'clock in the officers' schoolroom of the armory. The following papers were presented:—

"Business Conditions Relating to the Clay Working Industries," by John G. Jones; "The Importance of Chemical Stoneware in the Chemical Industries," by F. C. Kingsbury; "The Passing of King Methane," by S. R. Sholes; "Reducing Manufacturing Costs with Grinding Wheels," by F. B. Jacobs; "Art Division Research Suggestions," by F. H. Rhead; "Refractories," by J. Spotts McDowell; "Porcelain for the Laboratory," by Charles F. Binns; "Heavy Clay Products," by M. B. Greenough.

At 2.30 o'clock a symposium on "The Power Plant in the Chemical Industries" was opened, with R. C. Beadle in the chair.

In his opening address the chairman urged business firms to investigate conditions before giving up projects of expansion under the influence of rumors of competition of a sort impossible to meet. He cited instances of firms being scared out of the South American market by baseless reports of the extension of long credits by German competitors. Calling attention to the progress already made in the improvement of combustion practices, Mr. Beadle concluded with the following pertinent questions:—

May it not be that a generation hence we will read with wonder that America used to burn up thousands upon thousands of dollars' worth of the two score or more valuable materials derived from raw coal? Would it not be horse sense to stop wasting these materials now? Would it not be worth while to any plant to get its power from what would, in effect, be the refuse from the refining of its raw materials? But can you not see the scoffing, the resistance, the objection to change from old methods, the fear that the new process will not exactly fit the policy of the plants, the fear that capital will be reluctant to aid?

## BOILER FEED WATER TREATMENT

E. G. Bashore, of Rice & Bashore, in a paper entitled "Boiler Feed Water Treatment and Treatment Control," presented an illuminating review of the difficulties encountered in preventing boiler troubles due to scale formation, corrosion, foaming or priming, and caustic embrittlement. He pointed out the reason for these troublesome results of the use of ordinary water and compared critically the different methods employed to prevent them. After his discussion of the use of (1) boiler compounds, (2) feed water heaters supplemented with chemical dosages, (3) continuous tank systems, (4) the intermittent tank system, (5) artificial or natural zeolite, and (6) internal treatment with commercial reagents in definite and predetermined quantities, he summed up as follows:—

From a resume of the criticism peculiar to each of the six foregoing methods of feed water treatment it is not to be inferred that feed water treatment does not pay. The only reason for presenting the unfavorable side along with the commendable points of each particular type or method of purification is to emphasize the fact that no single scheme offers a panacea for all boiler water difficulties. It occasionally happens that a clever salesman installs a reliable type of purification apparatus on a fool proof basis—in practice the apparatus proves not to be fool proof—the consequence is a discarded apparatus and a disgruntled customer. On the other hand, if the objectionable points along with the commendable points originally had been pointed out, due care would probably have been exercised in operation with the counter result of a satisfied customer and a dividend paying apparatus. Control is the crucial word which frequently spells success or failure. As a summation let it be stated that any properly advised chemical treatment of boiler feed waters will return large profits as against the investment involved or the cost of treating chemicals provided the treatment is maintained under reasonably intelligent control.

## PREVENTION OF CORROSION

"The Prevention of Internal Corrosion in Pipes, Tanks and Other Iron and Steel Equipment" was the subject of a paper by Perry West, of the Anti-Corrosion Engineering Co. Mr. West described in detail how water is robbed of its injurious corrosive action by two methods. One method consists in preheating the water and removing from it all dissolved gases by means of special apparatus. The other deactivating method is based on the principle of letting the water act on other metal before it enters the pipes or tanks.

## PYROLYTIC DISTILLATION OF COAL

In a paper enitled "A New Method for Coking Coal as Required for Industrial Fuel," D. S. Chamberlin, of the Distillation Industries, Inc., told of results obtained with the Whitaker-Pritchard process. The results obtained with this process, the speaker enumerated as follows:—

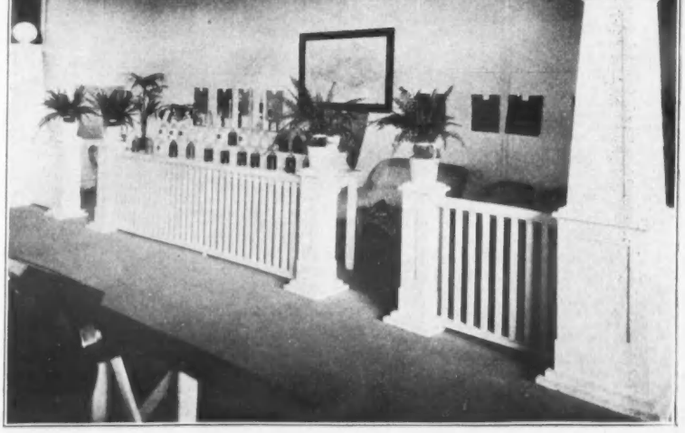
1. Coked a mass of run of mine coal 7 ft. x 4 ft. x 3 ft. high.
2. Carried on a distillation at a temperature less than 1,300 degrees F.
3. By the circulation of gases have uniformly controlled the best throughout the coking mass.
4. The making of a large yield of high B. T. U. gas, amounting to 14,000 cu. ft. per net ton of coal charged.
5. The recovery of a maximum yield of tars and oils, due to the scouring action of the returning partially condensed gasses.
6. Due to controlled low temperatures, can use steel as compared with higher priced ceramic materials.
7. The coking of the coal is carried on in the same time as by-product practice, the time being decreased by the increase of the pressure of circulating gases.
8. The size of a unit is only limited by the economic length of a steel tunnel and the proper control of heat there around.
9. The cost of operation per ton coal charged is low, as the usual expensive methods of grinding, handling and pushing are here eliminated.

Other contributions to the symposium were:—"Modern Boiler House Arrangement and Equipment," by R. M. Gordon, of the Solvay Process Co.; "Suggestions for Reducing Heat Losses in Chemical Plants," by John Primrose, of the Power Specialty Co.; "Compressed Air Installations in Industrial Plants," by A. R. Stevenson, Jr., of the General Electric Co.; "The Application of Electric Power in Chemical Industry," by D. B. Rushmore, J. A. Seede, and E. Pragst, of the General Electric Co.; "The Limitation of Silent Chain Drive," by F. C. Anderson, of the Morse Chain Co.; "The Application of Pulverized Fuel," by H. D. Savage; "Pulverized Coal in the Power Plant," by H. G. Barnhurst, of the Fuller Engineering Co.

## CHEMISTRY AND THE NATIONAL WELFARE

Dr. Charles L. Parsons, secretary of the American Chemical Society, addressed the Friday afternoon meeting on "The Master Key Industry."

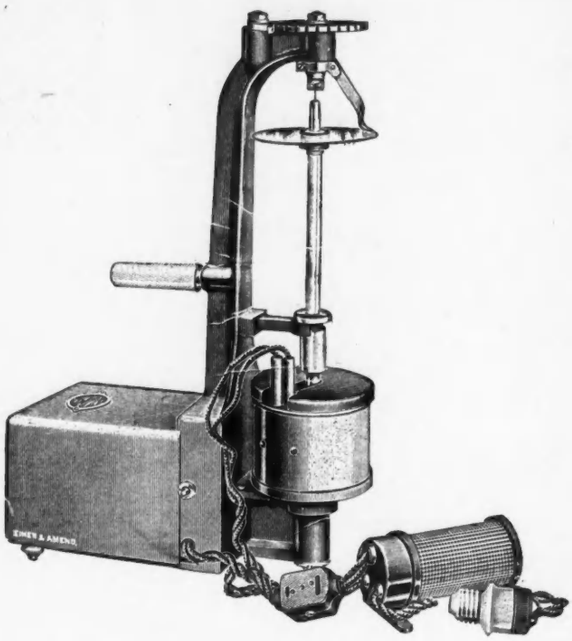
"Every pound of dyes purchased from Germany increases her armament and decreases that of America," said Dr. Parsons in pointing out the importance of chemical industry to national welfare. He was emphatic in his declaration of the necessity for a selective embargo to protect American organic chemistry. In elaborating the need for keeping up the chemical progress which has been but begun in this country, he said:—



Jacques Wolf & Co. Exhibit

# VISCOSIMETERS

## And OTHER FORMS of OIL TESTING APPARATUS



OUR stock includes the following—Autoclaves; Balances and Weights; Calorimeters; Colorimeters; Distilling Apparatus of various kinds; Flash Point Testers; Freezing Point Apparatus; Furnaces for Ash Test; Hydrometers; Thermometers, etc.

We carry a stock of all of the regular Viscosimeters including the Doolittle, the Engler, the Redwood, the Saybolt, the Scott, and the Stormer.

The latest developments in this field are the **Bingham** and **Green Plastometer** and the **MacMichael Viscosimeter,** both of which we stock. The MacMichael Viscosimeter (see cut) is especially recommended for Oils, Varnishes and Glues. For details of the Bingham and Green Plastometer write for Bulletin No. 277, and for details of the MacMichael Viscosimeter write for the new 32 page bulletin No. 280 where the various tests are given in detail.

## EIMER & AMEND

ESTABLISHED 1851

NEW YORK CITY
Third Ave., 18th to 19th Streets

PITTSBURGH BRANCH
4048 Jenkins Arcade


Plants manufacturing dyestuffs and other coal tar products are the greatest potential factors in our national defense. These plants are capable of producing greater destructive instruments than any other establishments. Actual armaments may be limited, but the country with the strongest coal tar industries will be able to dominate, and while Germany may be disarmed her main potential strength in reality lies in her enormous dye industry. Although we may agree to limit armament we can never agree to limit our chemical industries. Instead, we must develop and protect them.

Friday evening was devoted to the showing of motion pictures having to do with improved combustion practice, by-product coking, and the manufacture of iron, glass, cement and tile.

Prof. Charles Baskerville was the speaker of the evening, his subject being "Dyes and Coal Tar." He was a strong supporter of Dr. Parsons' opinion relative to the extreme importance of chemical industry from the standpoint of national security and progress, and joined with the earlier speaker in a plea for the adequate protection of the growing American industry.

# SATURDAY

In the matter of timeliness, Saturday's program was most interestng—that was "Dye Day." In the afternoon there was a symposium on "American Dyes and Colors," the chairman being W. P. Cohoe.

The address of the chairman was a comprehensive explanation of the processes now being employed in this country in making coal-tar dyestuffs, and a review of the progress that has been made. Following this address came a paper by F. E. Breithut, of the Calco Chemical Co., which was of timely every day value in its refutation of the charge that dye-making in America is monopolized. The text of this paper follows:—

## IS THERE AN AMERICAN DYE MONOPOLY?

*By Frederick E. Breithut*

Many good Americans are of the opinion that there is a monopoly in the dye-making industry.

What are the facts?

The following figures show:—

1. In 1914 there was no real dye manufacturing in the United States, simply seven plants in three States, assembling German intermediates into dyes.

2. In 1920 there were eighty-two American dye plants located in eighteen States.

3. In 1920 there were 213 coal-tar chemical plants located in twenty-five States.

In this connection it may be interesting to submit two quotations from official government reports.

The first is from "Artificial Dyestuffs Used in the United States," by Thos. H. Norton, Department of Commerce, Special Agents, Series No. 121, published in 1916:—

"The manufacture of coal-tar colors in the United States has been in existence some thirty-seven years. Prior to 1915 it had never become a factor of importance in supplying the American market.

"The American manufacture was confined almost entirely to the assembling into finished dyes of coal-tar intermediates imported from Europe, chiefly from Germany. In its entirety it represented less than one-tenth of the activity to be encountered in any one of the larger companies producing synthetic dyes in Germany and Switzerland."

Contrast this picture of national dependence with that presented by the following quotation from the United States Tariff Commission's Census of Dyes and Coal-Tar Chemicals, 1920:—

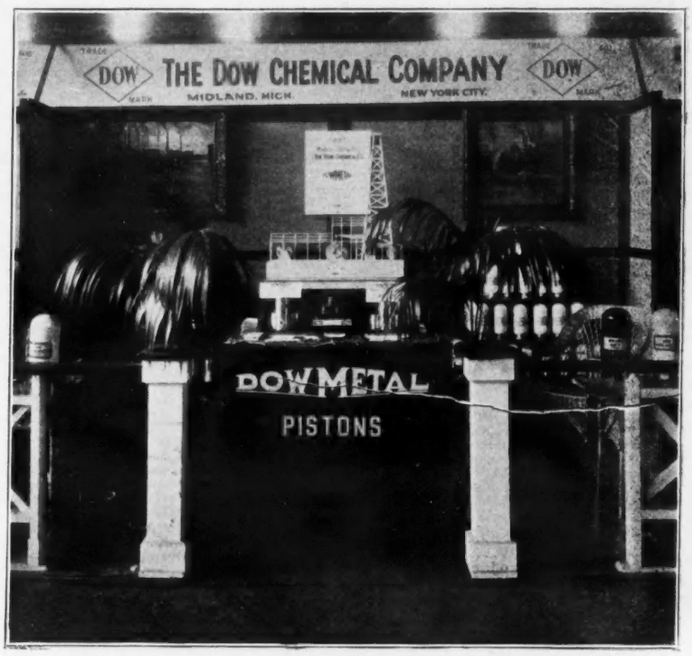
"The total number of firms engaged in the production of coal-tar products in 1920 was 213, while those companies engaged in the manufacture of dyes alone numbered eighty-two.

"The Tariff Commission has made a study of the number of firms producing each dye, which reveals significant facts concerning the organization of the domestic industry.

"Three hundred and sixty separate dyes were manufactured in 1920. Of these, 108 dyes, the output of which represented more than 90 per cent. of the total production, were each manufactured by three or more firms.

"Of greater importance, however, is the fact that those dyes, representing over one-half of the total quantity produced (thirty-five in number), were each manufactured by seven or more separate firms."

A closer examination of the Tariff Commission's census yields the data regarding dyes




Dow Chemical Co. Exhibit

### Census of Dye Production

| Schultz No. | Name. | Total production, 1920. Pounds. | No. of manufacturers, 1920. | Average price per pound. 1917. | 1918. | 1919. | 1920. | Aug., 1921. |
|---|---|---|---|---|---|---|---|---|
| 23 | Tartrazine | 701,722 | 5 | ... | ... | ... | $1.86 | $1.30 |
| 33 | Chrysoidine Y | 585,648 | 7 | $1.09 | $0.77 | $1.04 | .87 | .75 |
| 82 | Ponceau 2 R | 1,286,002 | 8 | 1.15 | .79 | .80 | .80 | .60 |
| 134 | Metanil yellow | 629,437 | 6 | ... | ... | 1.65 | 1.64 | 1.10 |
| 145 | Orange II | 1,850,341 | 12 | .98 | .68 | .63 | .62 | .45 |
| 181 | Salicine black U | 1,074,248 | 14 | ... | 1.62 | 1.25 | 1.10 | .60 |
| 217 | Algama black 10 B | 2,608,864 | 16 | ... | 1.26 | 1.47 | 1.29 | .85 |
| 283 | Bismarck brown | 514,218 | 11 | 1.17 | .81 | 1.01 | .84 | .70 |
| 307 | Congo red | 1,502,630 | 5 | ... | 2.01 | 1.12 | .86 | .60 |
| 333 | Oxamine black B H N | 803,501 | 6 | ... | ... | 2.72 | 2.97 | 1.40 |
| 337 | Benzo blue 2 B | 1,789,774 | 14 | 2.00 | 1.37 | 1.00 | .88 | .50 |
| 363 | Benzopurpurine 4 B | 617,629 | 11 | ... | 2.46 | 1.80 | 1.46 | 1.10 |
| 462 | Direct deep black E W | 7,736,994 | 14 | ... | ... | 1.04 | 1.03 | .65 |
| 463 | Erie direct black R X | 2,050,741 | 4 | ... | ... | ... | .99 | .70 |
| 476 | Benzamine brown 3 G O | 623,757 | 5 | ... | ... | ... | 1.60 | 1.10 |
| 495 | Malachite green | 654,237 | 6 | 6.28 | 5.60 | 3.26 | 3.32 | 2.00 |
| 515 | Methyl violet | 600,873 | 9 | 3.84 | 2.78 | 2.44 | 2.39 | 1.80 |
| 659 | Methylene blue | 577,264 | 12 | 3.09 | 2.80 | 3.03 | 2.94 | 1.50 |
| 698 | Nigrosine (spirit soluble) | 919,242 | 8 | 1.11 | .71 | .71 | .88 | .65 |
| 700 | Nigrosine (water soluble) | 2,743,021 | 6 | .80 | .63 | .59 | .72 | .58 |
| 720 | Sulphur black | 16,305,037 | 12 | .60 | .37 | .29 | .25 | .20 |
| | Sulphur blue | 1,514,811 | 9 | 1.63 | 1.45 | 1.11 | .98 | .70 |
| | Sulphur brown | 1,269,731 | 15 | ... | .48 | .47 | .35 | .30 |
| 874 | Indigo (synthetic) | 18,178,231 | 3 | 1.42 | .88 | .89 | .74 | .45 |

The above list contains all the dyes produced in quantities of 500,000 pounds or over, and represents 75 per cent. of the total 1920 production in poundage and 60 per cent. in value.

Even a cursory glance at these figures reveals:—

1. That the number of independent manufacturers of each of these large-tonnage dyes is sufficient to deny the existence of a monopoly.

2. In general, prices have shown a steady downward trend. (Of course, there are a few specific instances in which other factors, such as rise in raw material costs and imperfections in process control make this general tendency inoperative.)

### *In the Case of Intermediates*

What about the intermediates from which dyes are made?

Let us begin with a specific example.

You are all familiar with naphthalene. This commodity is one of the most valuable of coal-tar chemicals. According to the 1920 census there were forty-six important intermediates made from this coal-tar crude. The number of manufacturers producing each of these commodities is indicated in the following table:—

**Intermediates Factories**

| Name. | Number of manufacturers, 1920. |
|---|---|
| 2-Naphthol-3:6-disulfonic acid | 16 |
| 1-Amino-2-naphthol-4-sulfonic acid | 13 |
| 1-Naphthylamine-2-sulfonic acid | 12 |
| 1-Amino-8-naphthol-3:6-disulfonic acid | 12 |
| 2-Naphthol-6:8-disulfonic acid | 9 |
| Naphthalene, solidfying 79° C. or above | 9 |
| 1-Naphthol-4-sulfonic acid | 8 |
| 2-Naphthol-6-sulfonic acid | 7 |
| 2-Amino-8-naphthol-6-sulfonic acid | 7 |
| 1-Naphthylamine-3:6:8-trisulfonic acid | 7 |
| 2-Naphthylamine-6:8-disulfonic acid | 6 |
| b-Naphthol, tech | 6 |
| 1-Naphthylamine-5-sulfonic acid | 5 |
| 2-Naphthylamine-1-sulfonic acid | 5 |
| a-Naphthylamine | 4 |
| 1-Naphthylamine-8-sulfonic acid | 4 |
| 1:8-dihydroxy naphthalene-3:6-disulfonic acid | 4 |
| Phthalic anhydride | 3 |
| a-Naphthol | 3 |
| Phenylalphanaphthylamine | 2 |
| Nitronaphthalene | 2 |
| b-Naphthylamine | 2 |
| 1-Naphthylamine-6-sulfonic acid | 2 |
| 2-Naphthylamine-6-sulfonic acid | 2 |
| 1-Naphthol-5-sulfonic acid | 2 |
| 1-Naphthol-3:6:8-trisulfonic acid | 2 |
| b-Naphthol, U. S. P. | 2 |
| 2-Naphthol-7-sulfonic acid | 2 |
| 2-Naphthol-8-sulfonic acid | 2 |
| 1-Amino-8-naphthol-2:4-disulfonic acid | 2 |
| 8-Nitro-1-diazo-2-naphthol-4-sulfonic acid | 2 |
| Phthalamide | 2 |
| Chrononaphthalene | 1 |
| Ethylbetanaphthylamine | 1 |
| Naphthalene 2:7 disulfonic acid | 1 |
| 1-Phenylnaphthylamine-8-sulfonic acid | 1 |
| 1-Tolynaphthylamine-8-sulfonic acid | 1 |
| 1-Naphthylamine-3:8-disulfonic acid | 1 |
| 1-Naphthylamine-4:8-disulfonic acid | 1 |
| 2-Naphthylamine-4:8-disulfonic acid | 1 |
| 2-Naphthylamine-5:7-disulfonic acid | 1 |
| 1-Naphthol-3:6-disulfonic acid | 1 |
| 2-Naphthol-5:7-disulfonic acid | 1 |
| Dioxynaphthalene | 1 |
| 1-Chloro-8-naphthol-3:6-disulfonic acid | 1 |
| 1-diazo-2-naphthol-4-sulfonic acid | 4 |

If you will glance through the pages of the Tariff Commission's report, you will find that the case of naphthalene is typical of the whole list of coal-tar chemicals produced in our country.

This is made obvious by the data contained in the census table below.

The above list contains all of the intermediates produced in quantities of 500,000 pounds or more, and represents 80 per cent. of the total production of intermediates of the country for 1920 in poundage and 65 per cent. in value.

Again it is apparent that there is no monopoly and that prices have been coming down.

### *Color Lakes*

In the case of color lakes, the evidence presented by the record is equally striking. The following table shows the 1920 production and number of manufacturers of the most typical of these products:—

| Name. | Total production, 1920. Pounds. | No. of manufacturers, 1920. |
|---|---|---|
| Black lakes | 382,277 | 4 |
| Blue lakes | 645,647 | 31 |
| Brown lakes | 113,630 | 5 |
| Eosine lakes | 606,618 | 31 |
| Green lakes | 431,970 | 26 |
| Lithol red | 496,600 | 26 |
| Maroon lakes | 740,765 | 25 |
| Orange lakes | 120,183 | 16 |
| Para red | 970,589 | 9 |
| Red lakes | 4,410,797 | 35 |
| Scarlet lakes | 783,011 | 31 |
| Violet lakes | 336,969 | 28 |
| Yellow lakes | 536,122 | 26 |

Prices are not given for the reason that color lakes are sold in grades of such varying strengths that price comparisons are exceedingly difficult. It may be stated, however, that prices have been steadily declining.

No, there is no American dye monopoly!

Our dyes are being made by many manufacturers, some very large, some very small. They are all selling against one another in open competition.

As a matter of fact, every manufacturer who is actually in the business knows full well that the competition is not only in the open, but that it is really much fiercer than in most lines of business. Anyone is at liberty to go out with the salesmen of our dye companies, and we are convinced that a few days' experience will convince him that there is absolutely no monopoly in existence. If there were such a monopoly, it would seem that it must be very inefficiently managed to permit ten, twenty and thirty different independent plants to produce the same product, and also to permit a consistent reduction of prices throughout the list of the products which it manufactures. Increasing the output, decreasing the price, and permitting the existence of many plants producing the same article, thereby giving employment to a greater number of people, are actions not usually ascribed to a monopoly.

If you will take the trouble to look through the capital investments of our eighty-two dye makers, you will find that they vary from a few thousands to millions of dollars. An examination of the names on the boards of directors shows that there are no interlocking directorates, nor other forms of commercial control.

The truths enumerated above are simply so, and it is very difficult to believe that those who persist in reiterating that there is an American dye monopoly can be doing so through sheer ignorance of the facts.

**Census of Intermediates Production**

| Name. | Total production, 1920. Pounds. | No. of manufacturers, 1920. | Average price per pound. 1917. | 1918. | 1919. | 1920. | Aug., 1921. |
|---|---|---|---|---|---|---|---|
| Acetanilide | 2,667,252 | 9 | $0.46 | $0.53 | $0.41 | $0.42 | $0.33 |
| 1-Amino-8-naphthol-3:6-disulfonic acid (H acid) | 5,180,903 | 12 | ... | 1.69 | 1.32 | 1.23 | 1.15 |
| Aniline oil | 39,234,186 | 14 | .23 | .27 | .24 | .28 | .18 |
| Aniline salt (and sulphate) | 2,024,956 | 5 | .33 | .34 | .38 | .37 | .25 |
| Benzaldehyde | 702,543 | 8 | 2.72 | 2.40 | .78 | .63 | .45 |
| Benzidine base | 2,071,858 | 9 | 1.65 | 1.01 | 1.26 | 1.15 | 1.00 |
| Benzoate of soda | 812,193 | 8 | 3.30 | 2.38 | .88 | .79 | .50 |
| Benzylchloride | 1,246,412 | 5 | 1.20 | .66 | .23 | .22 | .20 |
| Chlorobenzene (mono.) | 4,829,142 | 6 | .20 | .18 | .15 | .10 | .14 |
| Dimethylaniline | 5,447,107 | 7 | .59 | .57 | .55 | .71 | .42 |
| Dinitrobenzene | 2,492,178 | 6 | ... | ... | .24 | .27 | .21 |
| m-Dinitrobenzene | 887,934 | 5 | ... | .28 | ... | .29 | .27 |
| Dinitrochlorobenzene | 5,947,791 | 6 | ... | ... | .21 | .24 | .20 |
| Dinitrotoluene | 1,847,191 | 11 | ... | ... | .35 | .32 | .25 |
| Naphthalene (refined) | 30,230,734 | 9 | .07 | .08 | .07 | .08 | .07 |
| b-Naphthol (technical) | 11,920,714 | 6 | .67 | .59 | .49 | .47 | .35 |
| b-Naphthol-4-sulfonicated | 561,929 | 8 | ... | 1.24 | 1.83 | 1.41 | 1.40 |
| 2-Naphthol-3:6-disulfonic acid (R salt) | 1,250,674 | 16 | ... | .80 | .72 | .66 | .65 |
| 2-Naphthol-6:8-disulfonic acid (G salt) | 1,446,605 | 9 | ... | ... | .82 | .68 | .60 |
| a-Naphthylamine | 5,177,547 | 4 | .44 | .50 | .41 | .34 | .35 |
| 1-Naphthylamine-4-sulphonic acid (naphthionic acid) | 3,773,191 | 12 | ... | .66 | .62 | ... | .60 |
| p-Nitroaniline | 2,138,492 | 6 | 1.13 | 1.30 | 1.06 | 1.17 | .80 |
| p-Nitro-acetanilide | 569,728 | 4 | ... | .77 | .69 | .68 | .60 |
| Nitrobenzene | 53,244,008 | 9 | .14 | .15 | .14 | .14 | .12 |
| p-Nitro-chloro-benzene | 959,405 | 5 | .29 | .33 | .21 | .32 | .32 |
| Nitrotoluene | 6,100,618 | 6 | ... | .30 | .17 | .13 | ... |
| o-Nitrotoluene | 2,173,279 | 4 | .72 | .69 | .23 | .13 | .15 |
| p-Nitrotoluene | 2,004,089 | 7 | 1.24 | 1.11 | .56 | .61 | .85 |
| m-Phenylenediamine | 658,313 | 15 | 1.35 | 1.10 | 1.01 | 1.06 | 1.00 |
| Salicylic acid (technical) | 3,914,163 | 8 | .66 | .57 | .29 | .29 | .20 |
| Su'phanilic acid | 1,796,838 | 13 | .30 | .29 | .24 | .36 | .25 |
| Toluidine | 1,145,361 | 6 | .76 | .81 | .38 | .37 | .40 |
| o-Toluidine | 1,302,697 | 8 | ... | .96 | .50 | .39 | .40 |
| Xylidine and salt | 1,054,476 | 8 | .65 | .54 | .53 | .47 | .40 |

Williams Haynes presented an able affirmative argument on the question, "Do We Want a Complete American Chemical Industry?" Other papers were:—"Making a Better America," by Charles T. Baylis; "The Psychology of Color in the Motion Picture Theatre."

A number of motion pictures were shown in the evening; only one had to do with the dye industry. It was "Making du Pont Dyes." Another picture of interest to Reporter readers was "Extraction of Alsatian Potash Salts and Refining Potassium Chloride," shown through the courtesy of the Societe Commerciale des Potasses d'Alsace.

In introducing the du Pont picture, Dr. R. E. Rose, of E. I. du Pont de Nemours & Co., spoke as follows:—

## THE DYE PLANT OF THE DU PONT COMPANY

*By Dr. R. E. Rose*

The story of a great achievement in the face of great difficulties is always one which appeals to Americans. The importance of the dye industry to the nation has been emphasized over and over again. My purpose today is to speak to you of what one company has achieved in making real the Americanization of that industry.

Rather than words, we will use an ocular demonstration, by presenting for your information a series of pictures taken in and around the dye works of this company. These, with all that bewildering mass of buildings and equipment, will make clear what has resulted from our efforts. It will be obvious that millions have been spent in the faith that the American people would see that the industry received the encouragement absolutely necessary for its growth.

Six years ago, the area now covered by the plant was a swampy South Jersey flat on the shores of the Delaware. That is a point to remember as you inspect the fine buildings which now stand on the former haunts of the mosquito.

I would ask you to pay particular attention to the magnificent group of experimental laboratories, one of which serves for the standardizing and testing of color, the technical laboratory; two which house the research chemists, responsible for pushing forward our knowledge of processes in order to make dyes better and cheaper, and two others which are semi-works buildings, serve the purpose of insuring that methods arrived at by experiment on a small scale are properly modified before they go to the plant. These five buildings embody the spirit of the company in their determination to see that nothing is left undone which will mean better products for the American user. These laboratories, because all of them are essentially laboratories, are the workshops of those who push forward into the unknown and bring home the fruits of knowledge.

Of the plant itself, it is impossible to convey any impression by words; it must be seen. Even these pictures represent it as black, colorless and silent, and free from the peculiar odors of a plant of this kind. I wish that we might have the pleasure of showing you the reality, of which these pictures give only a faint impression.

We shall be happy if they lead you to realize, even a little better, how determined the American dye industry is to continue its success.

# Complete List of Exhibitors

## A


| Name. | Space No. |
|---|---|
| Abbe, Paul O., Inc. | 106 |
| Abbe Engineering Co. | 436 |
| Abernethy, John F. | 143 |
| Acid Proof Clay Products Co. | 136 |
| Ainsworth, Wm., & Sons | 67 |
| Albany Chemical Co. | 722 |
| Alberger Chemical Machinery Co., Inc. | 839 |
| Alberene Stone Co. | 200 |
| Allis-Chalmers Co., Inc. | 128 & 229 |
| American Ceramic Society | 451 |
| American Chemical Society | 636 |
| American Chemical & Manufacturing Co. | 707 |
| American Cyanamid Co. | 434 |
| American Dyestuff Reporter | 16 |
| American Electrochemical Society | 405 |
| American Hard Rubber Co. | 619 |
| American La France Fire Engine Co. | 231 |
| American Manganese Bronze Co. | 616 |
| American Metal Co., Ltd. | 551 |
| American Metal Products Co. | 929 |
| American Perfumer & Essential Oil Review | 829 |
| American Steam Pump Co. | 742-744 |
| American Steel & Wire Co. | 435 |
| American Water Softener Co. | 438 |
| Anaconda Copper Mining Co. | 320 |
| Anaconda Lead Products Co. | 322 |
| Anaconda Rolling Mill Dept. | 324 |
| Angel, H. Reeve, & Co. | 624 |
| Anti-Corrosion Engineering Co. | 247 |
| Anti-Hydro Waterproofing Co. | 204 |
| Apex Chemical Co., Inc. | 201 |
| Arkell Safety Bag Co. | 540 |
| Armstrong Cork & Insulation Co. | 676 |
| Arnold Hoffman & Co., Inc. | 517 |
| Atlantic Engineering Co. | 141 |
| Atlas Electric Devices Co. | 908 |
| Avery Rock Salt Mining Co. | 538 |


## B


| Name. | Space No. |
|---|---|
| Bachmeier & Co., Inc. | 731 |
| Bahnson Co., The | 148 |
| Bailey Meter Co. | 236-238 |
| Bakelite Co. | 50-51 |
| Baker & Co., Inc. | 743 |
| Baker, J. T., Chemical Co. | 632 |
| Baker, Joseph, Sons & Perkins Co., Inc. | 827 |
| Barber Asphalt Paving Co. | 509 |
| Barrett Company, The | 417-419 |
| Bausch & Lomb Optical Co. | 750 |
| Beach Russ Co. | 537 |
| Becker, A. J. | 527 |
| Becker, Christian, Inc. | 740 |
| Beckley Perforating Co. | 56 |
| Belle Alkali Co. | 517 |
| Bethlehem Foundry & Machine Co. | 207 |
| Blackmer Rotary Pump Co. | 628 |
| Blakiston's, P., Sons & Co. | 15 |
| Blaw-Knox Company | 716 |
| Boyer, Kienle Co., Inc. | 530 |
| Bragdon, Lord & Nagle Co. | 834 |
| Bristol Co., The | 351 |
| British America Nickel Corporation, Ltd. | 450 |
| Brown, A. F., Co., The | 747 |
| Brown Instrument Co. | 308 |
| Buffalo Foundry & Machine Co. | 718-720-819-821 |
| Builders' Iron Foundry | 825 |
| Burrell Technical Supply Co. | 848 |


## C


| Name. | Space No. |
|---|---|
| Calco Chemical Co. | 327-329 |
| Canada: Department of Mines | 437-439-441-443 |
| Canada: Dominion Bureau of Statistics | 443 |
| Canada: Dominion Forestry Branch | 437 |
| Canada: Dominion Water Power Branch | 445-447 |
| Canada: Iron and Steel of | 12 |
| Canada: Pulp & Paper Magazine of | 12 |
| Canadian Chemistry & Metallurgy | 11 |
| Canadian Mining Journal | 12 |
| Canadian Pacific Railway Co. | 442-444-446 |
| Canadian Textile Journal | 12 |
| Carbrox Company, Inc. | 447 |
| Carborundum Co., The | 326-328 |
| Carrier Engineering Corporation | 319 |
| Cash, A. W. Co. | 904 |
| Celite Products Co. | 805 |
| Central Scientific Co. | 735 |
| Chadwick Boston Lead Co. | 314 |
| Chapman Stein Furnace Co. | 505 |
| Chapmain Stein Furnace Co. | 505 |
| Charleston Industrial Corporation | 643 |
| Chemical Age | 57 |
| Chemical Catalog Co., Inc. | 737 |
| Chemical Co. of America | 709-711-713 |
| Chemical Color & Oil Record | 8 |
| Chemical Equipment Co. | 425 |
| Chemical & Metallurgical Engineering | 221 |
| Chemical Pump & Valve Co. | 331 |
| Chemical Warfare Service | 642-644-646-648 |
| Chiris, Antoine, Co. | 513-515 |
| Cleveland-Cliffs Iron Co. | 544-546 |
| Clipper Belt Lacer Co. | 149 |
| Color Trade Journal | 427 |
| Colton, Arthur, Company | 831 |
| Commercial Solvents Corp. | 330 |
| Combustion | 349 |
| Contact Process Co. | 609 |
| Container Club, The | 746 |
| Cooper Hewitt Electric Co. | 913 |
| Coors Porcelain Co. | 533 |
| Corning Glass Works | 535 |
| Crane Packing Co. | 68 |
| Crane Co. | 335 |


## D


| Name. | Space No. |
|---|---|
| Darco Corporation | 511 |
| Davison Chemical Co., The | 138-140 |
| Davidson, M. T., Co. | 503 |
| De Laval Separator Co. | 608-610 |
| Department of Mines of Canada | 437-439-441-443 |
| Detroit Chemical Works | 609 |
| Detroit Range, Boiler & Steel Barrel Co. | 318 |
| Devine, J. P., Co. | 118 |
| Diamond State Fibre Co. | 731 |
| Dings Magnetic Separator Co. | 312 |
| Distillation Industries, Inc. | 244-246 |
| Dominion Bureau of Statistics | 443 |
| Dominion Forestry Branch | 437 |
| Dominion Water Power Branch | 445-447 |
| Dorr Co., The | 214-218 |
| Dow Chemical Co. | 602 |
| Draper Manufacturing Co. | 621 |
| Drug & Chemical Markets | 429 |
| Drying Systems, Inc. | 811-813 |
| Du Pont, E. I., de Nemours & Co., Inc. | 500-502-504-601-603-605 |
| Duriron Co., The | 249-251 |


## E


| Name. | Space No. |
|---|---|
| Eagle-Picher Lead Co. | 409-411 |
| East Jersey Pipe Co. | 611-613 |
| Economic Machinery Co. | 548 |
| Economy Engineering Co. | 701 |
| Egyptian Lacquer Manufacturing Co. | 539-541 |
| Eimer & Amend | 634 |
| Electro Bleaching Gas Co. | 408-410 |
| Electro-Chemical Supply & Engr. Co. | 829 |
| Electrolytic Zinc Co. | 542 |
| Elyria Enameled Products Co. | 407 |
| Elmore, G. H. | 514-516 |
| Empire Laboratory Supply Co. | 341-343 |
| Englehard, Charles, Inc. | 702 |
| Everlasting Valve Co. | 525 |


## F


| Name. | Space No. |
|---|---|
| Federal Phosphorus Co. | 2 and 3 |
| Fleisher & Co., W. L., Inc. | 130-132 |

Name. Space No.
Fletcher Works, Inc. 803
Florasynth Laboratories. 59
Foundation Oven Corp. 243
Foxboro Co., Inc. 309
Freeport Sulphur Co. 919
Fuel Products Corp. 244-246

G

Garrigues, Inc. 851
Geigy Co., Inc. 843-845
General Bakelite Co. 50-51
General Ceramics Co. 233-235
General Chemical Co. 421-423
General Electric Co. 211-213
General Filtration Co., Inc. 315
Georgia Lead Works. 314
Gibson & Price Co. 314
Glamorgan Pipe & Foundry Co. 206-208
Glens Falls Machine Works. 302
Goulds Manufacturing Co. 126
Graver Corporation 239
Grinnell Co.—Dryer Division. 102-104
Grinnell Co. 203-205

H

Haire Publishing Co. 809
Halvorsen, A. L. 311
Hanovia Chemical & Manufacturing Co. 55
Hardinge Co. 518
Hauser-Stander Tank Co. 313
Haynes Stellite Co. 723
Hays, Jos. W., Corp. 108
Hepworth, S. S. Co. 305
Hercules Engineering Co. 300
Heyden Chemical Co. 413-415
Hooker Electrochemical Co. 526-528
Howes Publishing Co. 16
Hoyt Metal Co. 314
Huff Electrostatic Separator Co. 724-726
Hungerford, U. T., Brass & Copper Co. 114
Hunter Dry Kiln Co. 812
Huyck, F. C., & Sons. 510
Huyette, Paul B., Co., Inc. 108

I

Illinois Zinc Co. 912
Industrial & Educational Press. 12
Industrial Filtration Corp. 234
Innis, Speiden & Co. 604
International Carbon Products Co. 728
International Cooperage Co. 62-63
International Nickel Co. 342-344
International Salt Co. 538
International Smelting Co. 322
Iron & Steel of Canada. 12
Irving Iron Works. 806
Isco Bautz Co., Inc. 604
Isco Chemical Co., Inc. 604

J

Jewell-Polar Co. 333
Journal of Commerce. 838
Journal of Industrial & Engineering Chemistry. 737
J. B. Lippincott Co. 839

K

K-B Pulverizer Co. 920
Kellogg, M. W., Co., Inc. 837
Kennart Synthetic Products Co. 623
Kennedy Valve Manufacturing Co. 836
Kewaunee Manufacturing Co. 735
Kiefer Karl Mch. Co. 833
Klipstein, A., & Co. 725-727-729
Knight, Maurice A. 721
Koppers Co., The. 348
Koppers Products Co. 350
Koven, L. O., & Brother. 823

L

Lakewood Engineering Co. 550
Lake Erie Chemical Works of General Electric Co. 215
Lamie Chemical Co. 807-809
Lead Lined Iron Pipe Co. 316
Leeds & Northrup Co. 337
Lefranc Chlorozone Works, Inc. 918
Lewis, Green, McAdams & Knowland. 65
Liberty By-Products Works. 532
Liquid Carbonic Co. 906
Little, Arthur D., Inc. 345-347
Lungmotor Co. 931
Lunkenheimer Co., The. 606
Luzerne Rubber Co. 17-18

M

McCready Publishing Co. 57
Maas & Waldstein Co. 650
Magna Metal Corp. 714
Magnesia Association of America. 301
Manhattan Rubber Manufacturing Co. 733
Manning, Maxwell & Moore, Inc. 431
Manufacturers' Record. 641
Mathieson Alakli Works, Inc. 736-738
Mead & Co. 106
Merck & Co. 600
Merrill Co., The. 519
Metals Disintegrating Co. 542
Midland Chemical Co. 411
Mine Safety Appliances Co. 848
Mineral Point Zinc Co. 523
Mojonnier Bros. Co. 933
Monarch Manufacturing Works, Inc. 4 & 5
Monel Metal Products Co. 344
Mono Corporation of America. 277
Monsanto Chemical Works. 712
Morse Chain Co. 630
Moto-Meter Co., Inc. 151
Mott, J. L., Iron Works. 506
Multi Metal Co. 607

N

Nash Engineering Co. 219
Nassau Valve & Pump Corp. 922
National Aniline & Chemical Co. 412-414-416-418
National Binding Mch. Co. 847-849
National Filter Cloth & Weaving Co. 66
National Gum & Mica Co. 23-24
National Lime Association. 745
National Research Council. 642-644-646-648
National Rosin Oil & Size Co. 810
Newark Wire Cloth Co. 346
New Brunswick Chemical Co. 625
New England Tank & Tower Co. 100
New Jersey Zinc Co. 521-523
New Method Utilities Co. 14
Newport Chemical Works. 706-708-710
New York Central Iron Works Co., Inc. 928
New York Commercial. 911
New York Continental Jewell Filtration Co. 802
Niagara Alkali Co. 408
Niagara Electro Chemical Co. 400
Nichols Copper Co. 402
Nitrogen Corporation. 738
Norwalk Iron Works Co. 449

O

Obermayer, S., Co. 524
Oil, Paint & Drug Reporter. 340
Oliver Continuous Filter Co. 321

P

Pacific Coast Talc Co. 604
Palo Co. 228
Paper Mill & Wood Pulp News. 147
Parks Cramer Co. 536
Pennsylvania Salt Manufacturing Co. 715-717
Permutit Co., The. 325
Perry & Webster, Inc. 61
Perth Amboy Chemical Co. 400
Petrei & Dorr, Inc. 214
Pfaudler Co., The. 719
Philadelphia Drying Machinery Co. 237
Philadelphia Quartz Co. 703
Pittsburgh Des Moines Steel Co. 54
Pneumercator Co. 230-232
Potdevin Machine Co. 21-22
Power, Nicholas, Co., Inc. 426
Power Specialty Co. 705
Powhatan Mining Co. 512
Precision Instrument Co. 134
Press Headquarters 403
Proctor & Schwartz. 220-224-226
Provost Engineering Co. 537
Pulp & Paper Magazine of Canada. 12
Pyrolectric Instrument Co. 58

Q

Quigley Furnace Specialties Co. 620

R

Raritan Copper Works. 320-322-324
Raymond Bros. Impact Pulverizer Co. 534
Raymond Lead Works. 314
Read Machinery Co. 52
Refinite Co., The. 210
Reliance Gauge Column Co. 108
Reo Motor Car Co. of New York. 631-633
Rhodia Chemical Co. 209
Robertson, Jas., Lead Works. 314
Roessler-Hasslacher Chemical Co. 400-501
Roto Co. 13
Ruggles-Coles Engineering Co. 69

S

Salmon Falls Manufacturing Co. 835
Sandoz Chemical Works, Inc. 142-144
Sandusky Cooperage & Lumber Co. 640
Sarco Co. 332
Schaeffer & Budenberg Manufacturing Co. 635
Schutte & Koerting Co. 150
Schwartz Sectional System. 817
Schwenck Carboy Tilter Co. 918
Scientific Equipment Co. 735
Scott Ernest & Co. 304
Semet-Solvay Co. 420
Seydel Manufacturing Co. 433
Seymour & Peck Co. 10
Sharpless Specialty Co. 406
Sheffield By-Products Co. 604
Sherwin-Williams Co. 336-338
Shriver, T., & Co. 824-844-846
Silica Gel Corp., The. 138-140
Sly, W. W., Manufacturing Co. 700
Snyderfiba Corporation 903-905
Society of Chemical Industry. 446-448
Solvay Process Co. 424
Southern Cotton Oil Co. 639
Southern Ry. System, Dev. Serv. 649-651
Sowers Manufacturing Co. 334
Standard Safety Equipment Co. 527
Stanley, W. W. 1
Standard Oil Co. of N. J., Chemical Products Division 440
Standard Water Systems Co. 339
Star Box & Lumber Co., Inc. 638
Star Corrugated Box Co., Inc. 638
Stein, Hall & Co., Inc. 404
Stimpson Equipment Co. 618
Stuart & Peterson Co. 921
Sturtevant Mill Co. 730-732
Sullivan Machinery Co. 629
Swenson Evaporator Co. 612

T

Tagliabue, C. J., Manufacturing Co. 531
Takamine Laboratory, Inc. 508
Talc and Soapstone Producers' Association. 808
Tanner, Charles S., Co. 508
Taylor Instrument Cos. 507
Technical Products Co., Inc. 401
Texas Gulf Sulphur Co. 307
Textiles 809
Textile Colorist. 64
Textile World Journal. 834
Thermal Syndicate, Ltd. 306
Thermo Electric Instrument Co. 615
Thomas Publishing Co. 850
Thwing Instrument Co. 910
Tolhurst Machine Works. 428-430-432
Tower Manufacturing Co., Inc. 625-627
Tyler, W. S., Co. 543-545

U

Uehling Instrument Co. 60
Union Steam Pump Co. 739-741
Union Sulphur Co. 614
United Chemical Co. 604
United Filters Corp. 120
United Hammer Co. 927
United Lead Co. 314
United Lead Co., Tatham Bros.' Works. 314
United Lead Co. of Cincinnati. 314
United Lined Tube & Valve Co. 314
United Metals Selling Co. 324
United States Cast Iron Pipe & Foundry Co. 310
United States Cooperage Corp. 645
U. S. Bureau of Foreign & Domestic Commerce. 841
U. S. Bureau of Standards. 248-250
U. S. Industrial Alcohol Co. 522
U. S. Industrial Chemical Co. 520
U. S. Stoneware Co. 617

V

Valley Iron Works. 748
Vallez, H. A. 241
Van Nostrand, D., Co. 25-26
Vitreous Enameling Co. 622
Voland & Sons, Inc. 804

W

Wailes Dove-Hermiston Corp. 53
Wallace, J. H., & Co., Inc. 647
Wallace & Tiernan Co., Inc. 303 & 202
Wedge Mechanical Furnace Works. 717
Westinghouse Electric & Manufacturing Co. 801
Wheeler, C. H., Manufacturing Co. 225
Wheeler Condenser & Engineering Co. 547-549
Whitall-Tatum Co. 704
Wilbur White Chemical Co. 604
Will Corporation. 145
Whitlock Coil Pipe Co. 6-7
Willson Goggles, Inc. 19-20
Winner Co., The. 339
Winslow & Co. 9
Wolf, Jacques & Co. 828-830-832
Worthington Pump & Machinery Co. 240-242

Y

Yale & Towne Manufacturing Co. 637
Young Brothers Co. 815

Z

Zavon Co., Inc. 930
Zeller Lacquer Manufacturing Co., Inc. 110
Zinsser Chemical Co. 645


## INDEX TO ADVERTISEMENTS


American Trona Corporation. xii
Anaconda Lead Products Co. xiv
Binney & Smith Co. xviii
Chiris Co., Antoine. xx
Consumers' Products Corp. ii
Draper Manufacturing Co., The. xxxii
Eagle-Picher Lead Company, The. vi
Eimer & Amend xxvii
Gray & Co., William S. xxii
Innis, Speiden & Co., Inc. xxxi
Knight, Maurice A. viii
Merck & Co. xvi
Michigan Iron & Chemical Co. xxiv
Mutual Chemical Co. of America. i
National Aniline & Chem. Co., Inc. xiv
Page & Co., Ltd., Chas. xxii
Pfizer & Co., Inc., Chas. x
Scott & Co., Ernest. iv
Semet-Solvay xviii
Wolf & Co., Jacques. xx


There is not a commercial center of any importance in any part of the World where the Oil, Paint and Drug Reporter does not circulate.

# THE BUYING POWER

*of the Clientele of the*

# Oil, Paint and Drug Reporter

## IS NEARLY FIVE BILLION DOLLARS

**This buying power is made up of the leading concerns in the following great industries**

¶ Chemicals and Allied Products; Dyestuffs, Natural, Coal Tar and Intermediates; Drugs and Pharmaceutical Chemicals; Fertilizers; Petroleum, Crude and Refined; Animal, Fish and Vegetable Oils; Paints, Varnishes, Glass, Naval Stores.

¶ Whether you are a buyer or a seller of any these products you would find it to your financial advantage to advertise in the Reporter, the weekly issues of which are consulted by Manufacturers, Importers, Manufacturing Consumers and Wholesale Distributers in all parts of the world.

¶ The Reporter is read by principals—those who have the final say-so—and that is one of the reasons why it has contributed so largely in the upbuilding of the industries it represents, and futhermore it is another reason why it is a great advertising medium.

¶ Begin your advertisement in the Reporter at once and thus avail yourself of the wonderful opportunity which it offers for the extension of your business to all parts of the world.

## Display Advertising Rates per Insertion

**This is a TWO INCH SPACE—**

| | | | | |
|---|---|---|---|---|
| 13 | weeks | $8.00 | per | issue |
| 26 | " | 7.00 | " | " |
| 52 | " | 6.00 | " | " |

**This is a FOUR INCH SPACE—**

| | | | | |
|---|---|---|---|---|
| 13 | weeks | $14.00 | per | issue |
| 26 | " | 12.00 | " | " |
| 52 | " | 9.00 | " | " |

**This is a SIX INCH SPACE—**

| | | | | |
|---|---|---|---|---|
| 13 | weeks | $17.00 | per | issue |
| 26 | " | 15.00 | " | " |
| 52 | " | 12.00 | " | " |

**This is a QUARTER PAGE—**

| | | | | |
|---|---|---|---|---|
| 13 | weeks | $26.00 | per | issue |
| 26 | " | 24.00 | " | " |
| 52 | " | 19.00 | " | " |

Oil, Paint and Drug Reporter Inc., 100 William Street NEW YORK CITY

# PURITY—
# STRENGTH—
# UNIFORMITY

1816-1921

*"Over a Century of Service and Progress"*

---

## INNIS, SPEIDEN & CO., Inc.

ESTABLISHED 1816

Manufacturers, Importers, Exporters of

## Industrial Chemicals

*Main Office:*

46 Cliff Street New York City

*Branch Offices:*

Chicago Philadelphia Boston Cleveland Gloversville, N. Y.

*Factories:*

Niagara Falls, N. Y. Jersey City, N. J. Murphysboro, Ill. Owego, N. Y.

Types of
DRAPER STEEL BARRELS
BLACK OR GALVANIZED
A Barrel for Every
Shipping Purpose
"What the Shipper Puts In
the Customer Takes Out"
Write for our Catalogue
THE DRAPER MFG. CO.
CLEVELAND, O. U. S. A.
DMC